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Photo by Olga Ley

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The Lungfish, the Dodo, and the Unicorn

Revised Edition

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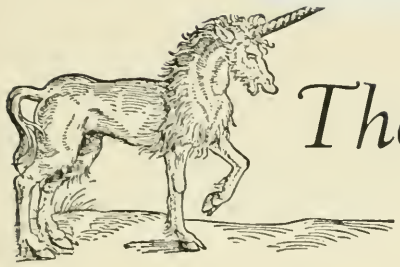

The Lungfish, the Dodo, & the Unicorn

An Excursion into Romantic Zoology

by WILLY LEY

New edition,

completely revised and considerably enlarged

New York · The Viking Press · 1948

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Preface to the Revised Edition

ONE OF the animals mentioned in this book, the so-called African lungfish, has a strange habit. When it gets too warm and too dry for comfort in its native habitat it goes into "estivation" (which is "summer-sleep," or the opposite of hibernation) by forming a kind of skin around its rolled-up eel-like body and a cake of river mud around that skin. And then it just waits for some water to come and dissolve the mud cake.

To my surprise, I found that this book behaved just like the lungfish of which it talks—be it understood, along with sea serpents, dinosaurs, shrews, koalas, basilisks, and unicorns.

The first edition of this book appeared in 1941 at a time when nobody yet knew that this would be the year in which war would come to the United States. But war did come, and one of the things that happened was that the publishing firm which had produced the book disappeared from the scene. It was drafted out of existence and the book was taken over by The Viking Press. Now, it is customary in the book-publishing business that all the books of one printing are not always bound at once. In the case of this book there were, after some time, about four hundred unbound copies left. And when all the bound copies had been sold and the publisher ordered the binding of the remaining copies they could not be found. No doubt somebody had "cleaned up," and the then current paper drive had benefited by whatever four hundred unbound copies of this book weigh.

The paper shortage prevented an immediate reprint, which would have been the normal and natural thing to do. Anybody could have said then that the book was dead.

But in the feeble manner which is characteristic of the estivating lungfish it stayed alive, as proved by a steady trickle of correspondence and (unfillable) orders. It just kept waiting for some water, or rather paper. And now the time has come for it to emerge and to look around once more.

The zoological handbook I'm consulting—one of those handy German publications of fourteen volumes, encyclopedia size—informs me that the African lungfish "does not appear emaciated" when it comes out of its softened mud cocoon.

That applies to the book, too; in fact, it has gained weight during the wartime drought. Half of the chapters of the present edition are either new or completely rewritten. Of the remainder, all have been partly rewritten to a varying extent; only a very few did not undergo any change at all. The latter represent the themes on which nothing has been learned since 1941 . . . maybe they are really closed chapters, maybe their turn will come next time.

Needless to say, that there are also a number of new illustrations, some of them replacing some that were printed in the first edition.

Willy Ley

Washington, D. C.
March 1948

Acknowledgments

SOME of the chapters of this book were first published as articles in various magazines, usually in a shorter version than appears here. The chapters on the unicorn and on the platypus appeared originally in *Frontiers,* published by the Academy of Natural Sciences in Philadelphia. Parts of the chapters on the wisent and urus and sections of the chapter on the ancestor of the domestic horse were published in *Fauna,* the magazine of the Zoological Society of Philadelphia. The chapters on the great auk, the Australian lungfish *Neoceratodus,* and the koala appeared in *Natural History,* the magazine of the American Museum of Natural History, New York. The drawing of *Neoceratodus* by Joseph M. Guerry was first published with the article in *Natural History,* and reproduction in this book is by kind permission of the editor of that magazine, Dr. Edward M. Weyer, Jr. The chapter on the Kraken appeared first under a different title in Street & Smith's *Astounding Science Fiction.*

In every case the editors of the magazines mentioned kindly granted permission for the use of these articles in this book.

Most of the drawings in the first edition of this book were by Professor Gustav Wolf, who died before the new edition was even under consideration. The job of replacing Professor Wolf as an illustrator was taken over by my wife, who devoted a great deal of patient work to the portrayal of creatures which she had never seen alive—except for the hedgehog and the Przhevalski horse.

W. L.

The Lungfish, the Dodo, and the Unicorn

Introduction: The Borderlines of Zoology

ZOOLOGY, the science of animals, is, of course, very old. I think it must have started with travel. A tribe of men living for many generations in the same terrain would regard the animals living in the same region from a purely utilitarian point of view. Their knowledge would be that of primitive hunters. Wild horses, for example, must have been classified as good to eat and not very dangerous to hunt; bison as even better to eat but also a little more dangerous; wolves as very dangerous and very unsavory; snakes, in spite of their small size, as extremely dangerous, and as for eating them, well, you could eat them, of course, but only if there were no larger steaks to be had. That was the primal division into "good" and "bad," from a strictly anthropocentric point of view.

But now imagine a tribe whose customary hunting grounds extend from the salty seas in the north to the white and brown hills in the south, and who are hemmed in in the east and west by large rivers. For many generations there has never been any need to cross these natural boundaries. The very thought of crossing them has gradually become taboo. Besides it cannot be done—this is the main reason for the taboo—though occasionally a hunter may catch himself with blasphemous dreams about ways and means of crossing the boundaries. Then, one year, a clamoring stomach proves stronger than the taboo. The tribe, or a part of it, learns to endure the monotony of the seemingly endless expanse of salty water. It learns how to brave the icy

winds in the mountains beyond the southern hills that had once formed the farthest outpost of the tribe's domain. The boundaries are crossed and recrossed.

And the returned travelers have tales to tell. The new land does not differ so very much from the old home country, despite the myths that have grown up about the ancient taboos. The hills did not open and swallow the invaders; the rivers were not fire, but sweet cool water. The grass is still green, there are the same meadows and swamps, forests and plains, hills and valleys. But one difference they have found, a difference not imagined before. There are new and strange beasts in the new lands.

And with this discovery another way of regarding animal species besides their division into "good" and "bad" has come into the world —plain curiosity. Now, animals could be interesting not only because they might be useful or harmful—but also because they were *new*. In time, men would actually set out "in quest of new lands and strange animals," as they still do. And no matter what his other goals might be, the traveler and explorer would always take pains to record the new varieties of animal life he encountered and, whenever he could, bring back with him physical evidence of it as the best kind of proof that he had actually landed on distant shores.

Aristotle is credited with having said that science begins with marveling, that is, with curiosity. And it is also Aristotle who, at the full noon of Hellenic culture, was among the first to take the next step in the beginning of zoological science. That first stage of scientific knowledge consists of the cataloguing of the known facts, the simple amassing of information, the compiling of "lists," or "treasuries" or "mirrors," as they were later to be called.

The first great landmark in this stage of the science of zoology was to come much later, however, when the center of political and cultural activity had shifted from Athens to Rome, and when Caius Plinius Secundus (A.D. 23-79), known as "Pliny the Elder," wrote his famous *Natural History* of about half a hundred books. This work shows a tremendous increase in the number of known facts and it marks, incidentally, the sunset of Mediterranean culture. Soon afterward the Roman Empire collapsed. "Darkness fell," as the historians like to

say, and the most valiant efforts of the Byzantines on the one hand and of the Arabs on the other could hardly preserve the knowledge gained, much less increase it and improve it. It needed the coming of the Renaissance, almost one and a half millennia later, to bring a continuation of the "quest for new lands and strange beasts." It needed the discovery of the Western Hemisphere and the opening of the Far East. It needed the unearthing of the Greek and Latin classics and their wider distribution through the newly invented printing press.

As far as the science of zoology is concerned, that long arctic night from Rome to Renaissance was at last dispersed by the voluminous *Historia Animalium* of Konrad Gesner of Zürich in Switzerland. The name of the diligent, learned, honest Konrad Gesner, this poor City Physician of Zürich, has come down to us adorned with two highly laudatory epithets. His contemporaries called him *Plinius Germanicus* (Gesner wrote in Latin, but even in his own time the German translation of his natural history was evidently more popular than the original; indeed, the German edition remained *the* natural history of expert and layman alike for two full centuries). The other appellation bestowed upon Konrad Gesner was posthumous; later generations spoke of him as "the Father of Zoology." This man, whose broad mind was a mirror of the classic knowledge, also started a new era.

Gesner's *Historia Animalium,* the first volume of which appeared in 1555, ten years before his death, was an extension of Pliny's *Natural History*. From the point of view of scientific method it was not, strictly speaking, an improvement, though of course there were enormous improvements in detail. The Roman Pliny had been a cavalry colonel and had wielded his stylus accordingly; if he had one firm belief, for instance, it was that all Greeks were liars. The German Pliny was a scholar; he also discerned that the Greeks had told more than they really knew, but he saw too that it was not because the Greeks were liars, it was because they were poets.

But fundamentally the Swiss natural history, like the Roman one, was a "list" of all the known animals and a "treasure" of all the known facts about them. It was still close to the first marveling in the development of zoology. The amount of knowledge had increased tremendously. Pliny had told all he knew about animals in one volume

of encyclopedic proportions; Gesner needed five such tomes. (The fifth, devoted to what we now term insects, was unfortunately not completed when in 1564–65 an epidemic broke out in Zürich and the City Physician, who had worked day and night to fight the plague, finally succumbed himself.)

The next stage in the development of zoology was not to follow until, two hundred years later, the Swedish savant Karl von Linné (Linnaeus) finally undertook the task which, according to the Book of Genesis, had been Adam's: to name all the animals and plants. Linnaeus realized that Adam had not made a very scientific job of it. True, the animals did have names, but these names not only differed from language to language (and often enough within the territory of one language, from province to province); they also lacked scientific accuracy and scientific usefulness all around. One particularly important thing could not be done with those "common" names: they could not be made to express relationships—they were of no use for classification. Gesner had used the "common" names, and that had forced him to arrange his animals in alphabetical order, no other order being possible. But Gesner had—with apologies to his readers—made a number of exceptions to his alphabetical rule. Domestic cattle, the wisent (European bison), the aurox, and some "other cattle from strange lands" obviously belonged together, and to treat them under the letters C (cow), B (bison), and A (aurox), respectively, would be to lose sight of their relationship. So also did the various breeds of dogs belong together, and so did the horse and the donkey.

Linnaeus's brilliant solution for this difficulty was the invention of double names, based entirely on Latin and Greek root-words. Thus cattle in general received the name *Bos,* and each kind received a second name which determined its variety. The aurox, already extinct in Linnaeus's time, became *Bos primigenius;* domestic cattle became *Bos domesticus;* the wisent or European bison became *Bos bison;* the Indian water buffalo became *Bos indicus.*[1] Thus the name demonstrated that they belonged together—that they formed a special group

[1] Some of these names were later changed for various reasons, and in comparatively recent times triple names were introduced, the third part usually denoting the geographic variety of the animal in question. Thus the American counterpart of *Bos bison* became *Bos bison americanus.*

or family among mammals. Horses became the *Equines,* the ordinary horse *Equus caballus* (the horse of the rider, the cavalier, the *caballero*), and the donkey *Equus asinus.* Then Linnaeus proceeded a step farther and established families, sub-classes, classes, and orders.

This task represented a tremendous amount of work. And while the result might look somewhat overwhelming at first glance, on account of the large number of forbidding Latin and Greek words, it was really an achievement of simplification. A multitude of facts had been brought together into a unified system of knowledge, each hitherto isolated fact falling into place in Linnaeus's all-inclusive "natural system." And no longer would it be necessary to memorize thousands of proper names in three or four languages, to learn *horse, cheval, Pferd;* it was *Equus caballus* whenever scientists were talking.

Then out of this achievement another thought—as we know now, the most important thought of all—began to grow and to take form. Linnaeus had talked of species and sub-species, of families and sub-families. Was it possible, was it conceivable, that these "families" of the system were actual families? That the relationships indicated by the first parts of the Latin double names not only expressed anatomic similarities but also might express genetic relationships? That these animals had not been created according to slightly changed blueprints but that they had evolved from one prototype, one original blueprint? That, for example, all the various kinds of *Bos* were diverging descendants of *one* original *Bos?* That, generally speaking, animals living now had evolved from others?

Linnaeus may have had thoughts of this kind while his system of classification took shape. If so, he probably found them disturbing, and ruled them out. He was attempting to bring rigidity and order out of chaos, not to suggest evidence of fluidity and change. Consequently he stated categorically that "the existing species of animals are now as they were created in the beginning." He would have admitted, probably, that a few more species had been created in the beginning than there were at the time he wrote; some animals were very rare and might become extinct any day. The important point was that no new species had appeared since Creation.

If Linnaeus's system had been less useful than it was and if Lin-

naeus had been less of an authority than he was, that one sentence would hardly have caused much trouble. As it was, that sentence, termed later somewhat ponderously "the dogma of the stability of the species," blocked the road ahead for a number of years. It needed the combined efforts of the Frenchmen Geoffroy Saint-Hilaire (father and son) and Lamarck, the Englishmen Darwin, Wallace, and Huxley, and the Germans Haeckel, Vogt, and Gegenbaur to overcome the immobilizing effects of that statement.

The early evolutionists, who had to fight Linnaeus's dogma, said many unkind words about it. And because of this, a great many of the followers of Darwin and Haeckel received the impression that Linnaeus had never done anything useful, that his place in the history of science was that of a stubborn reactionary whose name was known only because he had successfully opposed progress. It is, of course, difficult to contradict in a spirit of admiration. Actually Linnaeus's life work contributed more to the evolutionists than his dogma of the stability of species hindered them. Without his classification the evolutionists would not have had an orderly system from which to draw conclusions. They would have had only a mass of unrelated data grown to such proportions that it probably would have frightened off any attempt at classification. After all, it is easier to step over tabooed boundaries in a well-mapped territory than it is to find a path through a complete wilderness.

The names of Gesner, Linnaeus, and Darwin may be used to designate three stages in the history of zoology. Gesner represents the end of the first stage in the development, that of accumulating facts. Linnaeus represents the second stage, that of arranging and classifying those facts. Darwin represents the third stage, that of explaining them. Gesner was the answer to the question "What?"; Linnaeus to the question "How?"; and Darwin to the question "Why?"

Linnaeus had slammed a door: "The existing species of animals are now as they were created in the beginning." But between him and Darwin there came another important door-slammer. This was Cuvier, a very brilliant French scientist and founder of a science that is as fascinating in its subject matter as it is important: the science of paleontology.

Fossils had been known since classic times. Greek authors had described several petrified fish, suggesting that they might have developed from normal fish eggs that hatched in wet sand instead of water. Later on learned people somehow managed to evade fossils and the questions raised by them. If the fossils were large and impressive, mythological explanations were found; if they were small, they were taken to be mineral "freaks of nature" or experimental models made by God before the creation of actual living beings. Probably the first scientist who recognized all fossils as remains of creatures that had once been alive was a Swiss, Johann Jakob Scheuchzer. Scheuchzer wrote a *Defense of Fossil Fish*—a book in which the fossils speak bitterly plaintive theatrical lines. Their complaints are directed against Man, because by his sins and the consequent Deluge he had been responsible for their death. And, adding insult to injury, Man even denies that they are, or rather were, fish; and insists on calling them "mineral freaks."

Baron Georges Léopold Chrétien Frédéric Dagobert Cuvier agreed with Scheuchzer wholeheartedly. But there was an important difference. Scheuchzer had spoken about his fossil fish as about once living animals that had died individually. Cuvier began to speak of "extinct species," animals that had died out collectively—of whole species and even larger groups that no longer existed. Furthermore, once Cuvier and his followers began taking an interest in extinct species, they could not help noticing that there were "new" species too. Those in existence seemed not simply to have survived the extinct varieties but to have come later, after the others had died out.

With such conceptions Cuvier crossed another and very important boundary line. Since the dim days when the ancient tribal travel taboos had been broken, exploration had progressed steadily, if somewhat spasmodically, until it finally had embraced practically the entire earth. But, while unbounded in space, exploration had been strictly confined in time to the present or to the strictly historical past, the past of written human history. This was not by reason of any logic or prejudice, but simply because of the ignorance that there could be any other past. Cuvier crossed this boundary "in quest of new lands and strange beasts," and his report was of overwhelming interest.

Carried away by his own enthusiasm, he even made the sweeping statement that this new line of zoological research, the one he had opened, was the only one left that was still promising and worth following. In the past of the planet there were innumerable discoveries waiting to be made, whereas it seemed at least very unlikely, if not impossible, that there remained any living animals still to be discovered. While the first part of that statement was perfectly correct, as any fossil hunter since Cuvier knows, the second part was not merely an exaggeration; it was seriously wrong. The pages of this book teem with names of animals that have been discovered since Cuvier (early in the nineteenth century) made this statement. Indeed, some of our chapters will deal exclusively with animals still being sought in 1948. Nonetheless, we have Cuvier to thank for crossing the borderline between the animal world of today and that of the past, and for bringing to light the new worlds beyond it. It is not to his discredit that Cuvier himself did not dream how tenuous this boundary really is, that it is full of holes through which countless "living fossils" have slipped. It is merely amusing that Cuvier, the man who saw clearly that there was such a borderline and who boldly crossed it, did his very best to strengthen it, to plug the numerous gaps, and to deny its flimsiness in general.

Naturally Cuvier's discoveries and conceptions led him straight into a dilemma of a very special kind. The more he worked in his chosen field, the more extinct varieties he brought to light, the more he could not fail to see that some of these strange types, while apparently unconnected with anything living, bore a haunting resemblance to one another. They evidently represented another—another what? It was almost like having a collection of creatures of another planet, different from those of earth, differing widely also among themselves, but still belonging to the same creation. That was it, he thought: they *were* of another creation. Though these bones were of terrestrial origin, and not from another planet, they came from periods so remote in time that they nonetheless represented a distinctly different creation.

The great question was where to put this other and different creation in time. The Church allowed for about six thousand years since the creation of the earth itself. That figure had been derived from

the Bible by the learned Rabbi Shemayah Hillel as the result of the careful—though occasionally contradictory—adding up of the genealogical tables of the Old Testament from Adam to Christ. It is not specifically given in the Bible, as most people seem to believe. Six thousand years is not enough, however, to allow for two creations. Besides, the evidence seemed to indicate several different creations—and these could not possibly be squeezed into six short millennia.

Cuvier had to look for another and more convenient estimate of the age of the earth. There did exist another one, not based on tradition like Rabbi Hillel's, but on the physical experiments and mathematical calculations of Cuvier's compatriot, the Comte de Buffon. Buffon took a number of solid balls made of iron, copper, silver, and various kinds of stone, but all of the same size, and had them heated by a locksmith and placed on wire holders to cool. From time to time he touched them to test their temperature and noted the length of time in which the balls had cooled sufficiently to be touched without discomfort and when they had cooled "completely," that is, when they had reached room temperature. Then he made a number of calculations (he was an accomplished mathematician who translated Sir Isaac Newton's works) and arrived at what he thought to be the age of the earth. A ball of stone and ore the size of the earth, Buffon announced, would have needed 74,832 years to cool from white heat (which he took to be its state at the beginning) to the average temperature of today. The point at which the temperature began to be bearable to organic tissue dated 40,062 years back. "Therefore," concluded Buffon, "life began about 40,000 years ago and will continue to exist for another 93,291 years, when the earth will have cooled to one twenty-fifth of today's average temperature."

The pressure of the multitudes of Cuvier's extinct forms was growing and demanding some kind of explanation. Finally, with the help of Buffon's expanded time-scale of 40,000 years, Cuvier found one that seemed to work. It was in part based on evidence antiquated even in his time, and it had many features that were ridiculed at once, but so far as the diplomatic requirements went, it was a masterpiece of logical and literary elegance. It was the famous Theory of Cataclysms. It satisfied Cuvier's personal taste; it did not contradict Linnaeus's

dogma; and—just as important if not more so—it did not offend the ideas harbored at that time by the various Christian churches. Executed in a brilliant style, with all the superb rhetoric at the author's disposal, Baron Cuvier's book on this theory became a best-seller. This, briefly, is the theory:

In the beginning God created the world in general and our earth in particular and the plants on the face of the earth and the animals on the land and in the water. This, however, was not the Creation of the Bible. After a certain and probably lengthy time there occurred a cataclysm, a wholesale destruction of everything that had been created. Every known and unknown volcano shook the earth with violent eruptions; hot lava and ashes fell all over the planet and killed all life on the continents. The seas boiled for weeks, killing and cooking every living creature. The very air became glowing hot; there was no refuge, no survival. When the cataclysm finally abated, only the planet itself was left. Naturally it was dead and sterile; and if it were not to remain thus for all time to come, it needed a new creation.

A new creation took place. While fish and amphibians had been predominant in the first creation, another type of animal, reptiles, was characteristic of the second. The reptiles remained in power until the next cataclysm came. The third creation consisted mainly of mammals. The cataclysm that ended their rule differed in method though not in effectiveness. It was caused, not by heat and fire, but by cold and ice. When it grew warm again, the fourth creation followed, the one described in the first book of the Bible.

It follows, of course, that we are living in the interval between two cataclysms. No one can tell when the next cycle is due. There is a slender chance that God regards the present creation as perfect and final and that He will not destroy it. If another cataclysm were to come, it would certainly be as thorough as all the others. It is interesting—thought somewhat sad—to speculate on whether there will be intelligent beings in the fifth creation too, beings who will dig our bones from the rocks just as we, taught by Georges Cuvier, dig for the bones of animals from former cycles.

This theory of cataclysms established the idea of a succession of geological periods, for Cuvier made it clear that our own time, the Age

of Man, is only one among several ages in the history of the world, that it was preceded by other ages that did not know Man. But with this fundamental concept established, it was comparatively easy to progress farther, and the next step, as every schoolboy now knows, was to clear away Cuvier's artificial obstacles to an orderly and uninterrupted flow of geologic history. These obstacles were the cataclysms. After the first surprise effect wore off, nobody believed in them very seriously. Goethe called them a *vermaledeite Polterkammer der Weltgeschichte* ("accursed pelting chamber of world history"), the existence of which he refused to acknowledge.

The man who succeeded in disproving the existence of cataclysms and in wrecking the whole theory beyond repair was an Englishman, Sir Charles Lyell. Lyell quietly discarded the slightly hysterical outbursts from the Continent and replaced them with *time*. He showed that all the geological changes of the past could be explained by the continuous action of those natural forces we know from everyday life. Wind and rain, the grinding surf, flowing rivers, melting ice, can change the face and even the outline of continents, he declared, if only they are granted enough time in which to work. Lyell was not at all satisfied with the figures Buffon had estimated from his cooling metal and stone balls. He wanted *much* time, *more* time, and *still more* time. The term "a million years" was employed, somewhat jokingly at first, then seriously—and finally merely as a unit for the measurement of time.

The question of geologic time underwent a rather amusing development. More than one scientist set out to investigate the duration of earth's geologic history in order to prove to Lyell and to his followers that there simply was no past long enough to satisfy their demands, only to end up by granting even more time than his former antagonists had been discussing. At first these generous claims and what turned out to be even more generous counter-claims were a family matter among geologists, but soon astronomers and physicists joined in, and when finally radium and radioactivity were discovered, time was again considerably extended—in fact multiplied—until at present a grand total of about two billion years is generally accepted.

Because he also slammed a door shut, Cuvier has been given even

more contemptuous treatment than Linnaeus. It is forgotten that his cataclysmic theory was in a sense forced upon him not only by the religious bias of his age but also by the shortness of the period granted him by the science of his time. To compress so many fossil forms into forty millennia would require changes of catastrophic rapidity and completeness. In the end it was the necessary thoroughness of Cuvier's cataclysms, with their wholesale destruction of all life, that destroyed the validity of his theory.

Since Cuvier defined a cataclysm as a catastrophe embracing the whole earth and wiping out every form of life, it followed that it was impossible for any kind of creature to exist in more than one period. Cuvier did not merely imply this, he said it. *L'homme fossile n'existe pas,* he wrote: fossil man does not exist. For if an animal of the Third Age could not survive to see the Fourth Age, no recognized Fourth Age animal could be expected to turn up in the fossil state in layers formed during the Third Age.

And if an animal were discovered that was undeniably a "living fossil"—that is, an animal that was still alive even though it had already existed during a preceding period—the idea of cataclysms was bound to perish in a cataclysm itself. The same would happen if somebody discovered genuine fossilized human bones in undisturbed layers from another period. The cataclysmic theory was one of those that had to be either completely accepted or completely rejected; there could be no compromise. And as a matter of fact, some living fossils —as, for example, the sharks in the seven seas—were already well known during his time, though they were not yet recognized as such. In the end Cuvier's hypothesis was actually discarded not on the ground of one such discovery but on general grounds. Lyell saw to that.

The first volume of Lyell's book, *The Principles of Geology,* had just appeared when a young British naturalist embarked for a leisurely trip around the world. The young man took a copy of this book with him when he stepped aboard the *Beagle.* His name was Charles Darwin, and when later during his trip he found evidence forcing the idea of evolution upon him, the main obstacle that would have prevented such a conception—Cuvier's cataclysms—had been cleared away

by Lyell's work. Only forces that existed here and now had shaped the face of the earth from period to period. There were no interruptions. Consequently there was no need for a series of creations. What if Linnaeus was wrong and the species failed to remain the same? What if those species were shaped and reshaped slowly, almost imperceptibly, by forces that are also operating at present? If so, it must be possible to find these forces. While they might be too slow to watch at work, the evidence offered by Cuvier himself and by his followers might permit us to watch these forces in the past to see what they had done.

When Darwin returned from his trip, the theory of evolution had been conceived. That he needed several decades to develop it to a point where he thought it ripe for publication is a historical fact, but unimportant. What he did with his wondering thoughts during his visit to the Western Hemisphere represented the third stage in the development of zoology, of which Gesner's lists had been the first and Linnaeus's system the second. Now the scientific double names were to lose their lowly status as convenient handles of classification and become an expression of natural relationships.

The theory of evolution turned out to be the dawn of a new and very busy day in zoology and in general in all the sciences that deal with living things. Although it caused—naturally—a lot of controversy and although both sides in those controversies can be accused of having made senselessly sweeping statements and even wrong assertions, the general feeling that emerged was that this, at long last, brought some sense to the whole of these sciences. In some respects all other sciences had been better off for quite some time. The chemists knew that all substances were merely combinations of a small number of elements, the mathematicians could reduce the many complexities of their sciences to a few basic operations and concepts, and the historians had always been able to say that "the king's son did this and that because his father had done thus and so," or statements to that effect.

Now zoologists could describe events in the manner of historians, could look for basic assumptions and operations like mathematicians, hunt down missing "elements" like chemists.

But this book is not concerned with the main stream of these events. They are interesting and good textbook material, but such textbooks exist by the carload. This book is interested in some bypaths, unexpected turns of events, cases which interrupted routine, facts which made learned men sit back and say "Now I remember that somebody once told me . . ."

Such bypaths and sudden turns fall more or less clearly into the three groups into which the book is subdivided. As may be expected of living things, some don't fit even those large classifications precisely. It does not matter, because, after all, the whole discussion will be about things which did not fit properly at one time, up to and including the present.

EXPLANATION OF CHART

The names of the five eras are derived from the Greek (*archaios* = very old, *proteros* = first, *palaios* = old, *mesos* = middle, *ḳainos* = new, and *zoön* = animal). The names of the periods are usually geographic, and are derived from the names of the territories where rocks characteristic of the given period were first found or recognized. Thus, *Cambria* is Latin for Wales; the Silurians lived in South Wales; Devonshire (Devonian) is in England; *carbo* is Latin for coal; Perm is a province of Russia. *Trias* actually means trinity, as there are three marked subdivisions in the Triassic Period. The Jurassic Period derives its name from the Jura Mountains between France and Switzerland, and the Cretaceous Period from the Latin word for chalk.

The Cenozoic Era actually comprises a single period, the Tertiary, which in turn is divided up into the sub-periods given above. The name "Tertiary" reflects the older classification, according to which there were only three main periods (i.e., eras), of which the Tertiary was the third and last. The subdivisions of the Cenozoic Era or Tertiary Period again bear Greek names. *Palaios* (old) and *ḳainos* (new) are compounded into "Paleocene." The roots for the other names, in chronological order, are: *eos* (dawn), *oligos* (a little), *meios* (less), *pleios* (more), and *pleistos* (most). The Pliocene Period therefore means "the more new period," and Pleistocene "the most new."

Duration and Order of Geological Periods

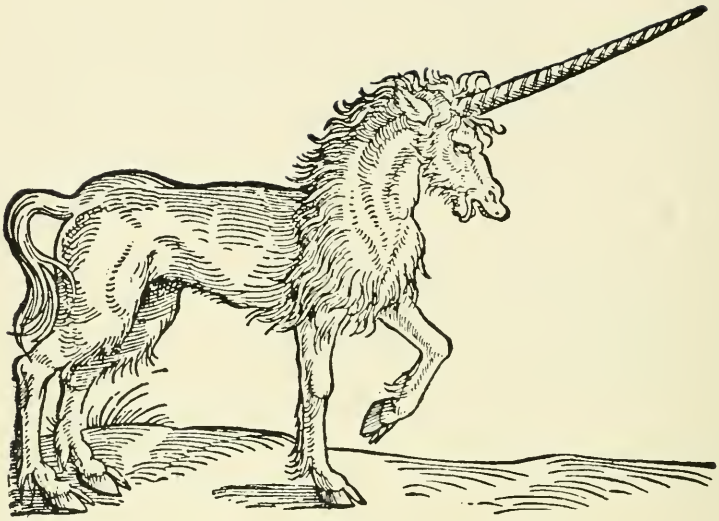
ERAS	PERIODS	DURATION (*millions of years*)	FAUNA	
	Recent (to date)	0.03	True Age of Man	
	Pleistocene	1	Ice Age, Early Man	
Cenozoic (or "Tertiary Period")	Pliocene	6	Pikermi Fauna, Okapi	Age of Mammals
	Miocene	12		
	Oligocene	16		
	Eocene	20	Amber, Dawn Horse	
	Paleocene	5	Insectivores	
Mesozoic	Cretaceous	65	Opossum, Last Saurians	Age of Reptiles
	Jurassic	35	Solnhofen Fauna	
	Triassic	35	Early Saurians	
Paleozoic	Permian	25	Early Ice Age, Monotremes	
	Carboniferous	85	Coal, Amphibians	
	Devonian	50	Fishes like *Latimeria*	
	Silurian	40	First Fishes, Trilobites	
	Ordovician	85		
	Cambrian	70	Invertebrate Sea Life	
Proterozoic	Upper Precambrian	650	Primitive Sea Life	
Archeozoic	Lower Precambrian	650	Unicellular Life	

Part One

MYTH?

"I shall endeavor to keep my mind free so as to give up any hypothesis, however much beloved, once facts are shown to be opposed to it."

—Charles Darwin



Konrad Gesner's unicorn

(From *Historia Animalium,* vol. I, Zürich, 1551)

1: *The Legend of the Unicorn*

The Pegasus with its wings and horse's head sounds very much like a legend, just as does the Gryphon in the country of the Moors. Also the Tragopan, of which many say that it is larger than an eagle, that it has curved horns and a red head, while the rest of its body is rust-colored. The Sirens should also be disbelieved, even though Dino, the father of the celebrated Clitarchus, claims that there are some in India and that they lure human beings by their song in order to tear them apart when they come close.

THIS outburst sounds as if it were written some time during the early Renaissance in an attempt to clean out of animal lore the debris produced by the overly fertile imagination of centuries of secluded life in monasteries. Actually, however, these sentences are much older. They come from Pliny's *Natural History*. Pliny, honest, industrious, and trained by military life to stick to solid facts only, disliked taking things for granted, although it may seem to us that he was sometimes uncritical. He was especially skeptical where the Greeks were concerned, and many animal stories had come to Rome via Greece. That made it practically certain that fancy had been added to the facts, if facts there were at all. Pliny, in short, endeavored to separate reports from myths, and to a certain extent he succeeded. But one very important mythical monster he did not bring himself to deny the existence of—the unicorn.

There is no doubt that the unicorn is the most glorious of all the mythical creatures to be found in books before and also after Pliny. Its legend is the oldest; it was not only one of the first to be whispered

about, it was also the last to disappear. No other mythical animal was ever so familiar and so elusive, so mysterious, so famous, so persistent as the unicorn. Even in our own time, which certainly is not given to mysticism in the realm of natural history, the unicorn has retained much of its charm and glamour, though no one any longer believes in its actual existence.

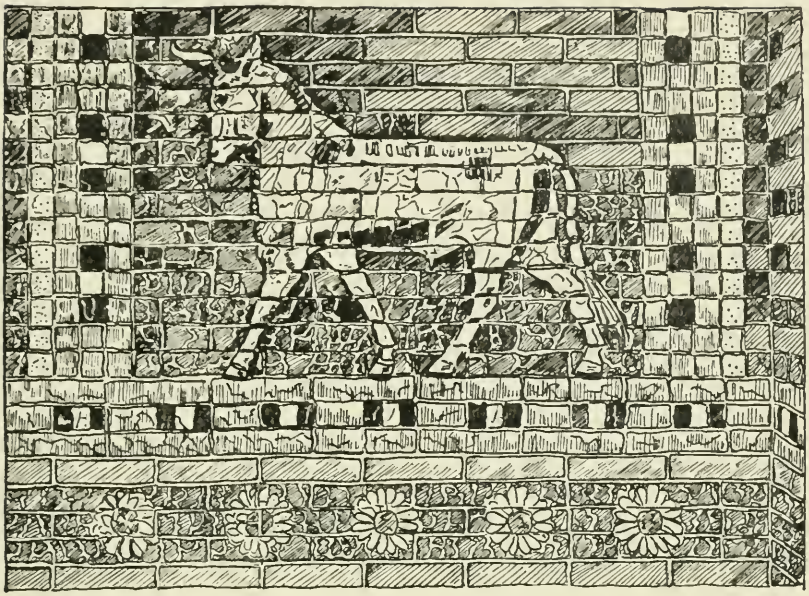
That the unicorn attained such fame and managed to maintain it for almost twenty centuries is due to many causes. It was first reported from a country which was a wonderland in itself: India. It was like nothing else on earth; it was not simply something gigantic, like the roc or the dragon; it was "different" in every respect. It was said to be rare even in its home country, and at least one of its parts was very valuable.

It was said that its horn—referred to as "alicorn" to avoid the cacophonous "unicorn-horn"—was an unfailing antidote against any kind of poison an assassin might concoct. And it worked in a number of truly miraculous ways. Scrapings from the alicorn could be taken internally to counteract poison already swallowed. Or the alicorn could be fashioned into a beaker so that the poison would be eliminated in advance. Or if the horn were used to touch the food, it would then betray the presence of the poison and thus guard the feasting king or nobleman. Naturally such properties made alicorn highly desirable among rich and powerful people. In that way it acquired a "noble" flavor, became incredibly expensive, and reflected on the animal that produced it.

These traits had not yet been assigned to it when Pliny permitted the unicorn to pass in his "list" as actually existing. He treated it soberly and seriously as an animal of the Far East and of India, for which there was some justification.

Shortly after Pliny's death the new Christian faith began its slow conquest of the Roman world, and it was from this quarter that belief in the unicorn received its strongest support. The reason for this lay in certain passages of the Bible, especially the references in Job xxxix, 9-12:

> Will the unicorn be willing to serve thee, or abide by thy crib?



Reem of the Ishtar Gate: so-called "unicorn of Babylon," actually the urus or aurochs

Canst thou bind the unicorn with his band in the furrow? or will he harrow the valleys after thee?

Wilt thou trust him, because his strength is great? or wilt thou leave thy labour to him?

Wilt thou believe him, that he will bring home thy seed, and gather it into thy barn?

Later scholars, to be sure, have shown that the beast referred to was an entirely different animal. But this fact was not realized until fairly recently, and for many centuries the unicorn was safe from doubt because it was apparently mentioned in the Scriptures. It is interesting to digress for a moment and see how it got there.

The famous Seventy who translated the Old Testament from Hebrew into Greek, and who produced what later became known as the Septuagint Version, discovered an unknown animal in certain passages of the text. The Hebrew seers responsible for the original spoke with

some awe about an animal they called the *reem*.[1] It was not stated of what size the reem was, nor was it described in plain zoological terms. Not even a comparison with another better-known animal was made. All that could be gathered was that the reem must have been—or still was—fierce, fleet, and untractable in every respect. It is not reported how long the Seventy hesitated before deciding upon a Greek term, but finally, possibly under the spell of dim recollections of half-obscure rumors, they substituted for reem the word *monokeros,* that is, unicorn. Later translators of the Bible, following the Septuagint, had no choice but to translate *monokeros* into their respective languages: the Vulgate said *unicornus,* the French Bible *licorne,* and Martin Luther wrote *Einhorn,* all meaning the same, namely, one- or single-horned.

This translation, possibly a mere blunder on the part of the Seventy, who were not very strong on zoology and the allied sciences, possibly a well-considered substitution of one unknown animal for another, caused the Christian world centuries later to believe in an animal which it might otherwise have rejected. The passage in the Book of Job is, incidentally, not the only mention of the unicorn in the Bible; there are seven altogether, three of them in the Psalms.

This explains why the unicorn escaped another attempt at cleaning up—an attempt that was not very effective anyway—undertaken by no less a personage than St. Bernard himself. St. Bernard, who must have been an eminently practical man, was thoroughly disgusted with the riotous imagination of the artists of his time and did not hesitate to scold them, and those who employed them, roundly:

> What business have those ridiculous monstrosities, those amazingly freakish beauties and marvelously beautiful freaks in the cloisters right in front of the eyes of the monks who are supposed to be reading or meditating? You see one head with many bodies or one body with many heads. Here you have a serpent's tail attached to a quadruped and there a mammal's head attached to a fish's body. There you have a creature that is half horse and half goat, and here one with horns and the rear end of a horse. . . . Great God, if they do not feel shame about the nonsense they produce why don't they at least shun the expense!

[1] In order to avoid multiple repetition of a strange-looking word the simplified spelling of "reem" has been used. The proper way of spelling this Hebrew word would be *Re'em* and the pronunciation is *ray-emm.*

If St. Bernard did have the unicorn in mind when he referred to the creature "with horns and the rear end of a horse," he was careful not to say so. After all, the unicorn *was* mentioned in the Bible.

As to the later attempts at zoological identification of the reem, it was mistaken for a while (by Samuel Bochart and others) for the oryx antelope. One reason for this conjecture was the fact the Arabs call the oryx *rim;* the other was that the oryx was proverbially a formidable enemy both to humans and to other animals in the ancient world. But this logic, sound as it apparently was, soon collapsed when an animal *rimu* was discovered in Assyrian texts. This time, however, there were pictures accompanying the text, and zoologists had little trouble in identifying the wild ox of the Assyrian and Babylonian bas-reliefs, the urus or aurochs, the *Bos primigenius* of their catalogues, the largest and most formidable wild ox that ever existed. This ended the search for reem's identity.

It now remains to trace the second part of the blunder of the Seventy: the *monokeros,* which they substituted for reem, what was it? And here the story of the unicorn begins in earnest.

The unicorn made its first appearance in the writings of Ctesias, Greek historian and one-time body physician of the Persian King Artaxerxes II. Ctesias returned from Persia around the year 398 B.C., and while residing at Cnidus wrote two works. One of these was a history of Persia in twenty-three books, of which all but fragments have been lost. The other was a book on India, and is still known to us in the form of a condensed abstract made some thirteen hundred years later by one Photius, then Patriarch of Constantinople. Part of this abstract runs as follows:

> There are in India certain wild asses which are as large as horses, and larger. Their bodies are white, their heads dark red, and their eyes dark blue. They have a horn on the forehead which is about a foot and a half in length. The dust filed from this horn is administered in a potion as a protection against deadly drugs. The base of this horn, for some two hands'-breadth above the brow, is pure white, the upper part is sharp and of a vivid crimson; and the remainder, or middle portion, is black. Those who drink out of these horns, made into drinking vessels, are not subject, they say, to convulsions or to the holy disease [epilepsy]. Indeed, they are im-

mune even to poisons if, either before or after swallowing such, they drink wine, water, or anything else from these beakers. . . .

This report, a few lines that grew into a library of hundreds of volumes, needs a few words of explanation. Ctesias in writing about India wrote about a country he had never seen for himself. If the parts preserved by Photius are a fair sample of the original, his book was a compilation of hearsay, a description based on the tales of travelers, and it probably bore no stronger resemblance to its subject than an American movie does to American everyday life.

It is fairly easy to see that the "wild ass of India" in Ctesias' book is based on the Indian rhinoceros, with admixtures of features of some other animal. That there "is much rhinoceros in it" can be asserted without lengthy discussion. Not only is the rhinoceros the only truly one-horned animal, but it has also other features that agree with Ctesias' story. He mentioned somewhere else, for example, that this animal is swift of foot and that its speed increases while running. This applies to the rhinoceros. It also corresponds with facts of rhinoceros lore that the horn was said to be of pharmaceutical value. Rhinoceros horn was and still is considered a powerful drug in the Far East, and wealthy and elderly Chinese literally pay its weight in gold because they hope to regain their manhood by taking pulverized rhinoceros horn internally. Beakers of rhinoceros horn were frequent even in ancient times. And some of them were adorned with the three colors Ctesias described as the natural colors of the horn. It is probable that there was some mystic value attached to this color scheme, although we do not know now what or why. Those features of Ctesias' "wild ass" that are not traceable to the rhinoceros probably came from an antelope of some sort. The blackbuck of the English suggests itself, and it is an odd coincidence that the natives of the countries where these antelopes abound still claim that there are many one-horned freaks among them.

Another school of thought, led by the German Professor Schrader, cited Ctesias as a witness to the fact that the origin of the unicorn legend is the reem. Professor Schrader pointed out that Assyrian and Babylonian bas-reliefs show the urus in very strict profile, so strict,

in fact, that only one horn is visible. Dr. Othenio Abel of Vienna and Professor C. Antonius strengthened Professor Schrader's arguments in calling attention to the fact that these famous bas-reliefs—aside from being somewhat heraldic in design—are not absolutely accurate in detail. Although there is no mistaking the general appearance of the urus, small details are either missing or wrong, because the artists no longer had live models at their disposal. The bas-reliefs date from the time of King Nebuchadnezzar (around 600 B.C.) when the urus had already been extinct in Mesopotamia for about a century. When the Persians saw these bas-reliefs and copied them on the walls of the Royal Palace of Persepolis, the urus was already a somewhat fabulous monster. Its size, strength, and fierceness made it particularly apt to become a mythical animal within a short period of time. When Ctesias the Greek came to Persia and saw the Persian copies of this animal he had never heard of before, there was in all probability a sufficient supply of fables on hand and waiting to be related to traveling foreigners. Also, it can be safely assumed that Ctesias was only superficially acquainted with the languages he heard spoken around him in Persepolis. Being a Greek, he was, if one may trust the judgment of Roman authors, "a bad linguist, a bad naturalist, and a liar."

In spite of all this I do not think that Ctesias was noticeably influenced by the Persian reliefs. The next important sources of the unicorn legend after Ctesias point another way. These sources are the Roman Aelian, who wrote in Greek although he lived in Italy, and our friend the famous grouchy old colonel, Pliny the Elder.

Aelian spoke of inaccessible mountains in the interior of India and of the strange beasts that could be found there. Among them, he said, "is the unicorn, which they call *cartázonos*. This animal is as large as a full-grown horse, it has a mane, tawny hair, feet like an elephant, and a tail like a goat. It is exceedingly swift." At first glance descriptions of this kind seem to be merely *caprices zoologiques,* with the unicorn growing more and more fantastic. Actually Aelian was only trying to describe the rhinoceros, its heavy feet, its small tail, and its other characteristics. The name *cartázonos* is probably a Greek corruption of the Sanskrit word *ḳartajan,* Lord of the Desert, or, better, Lord of the Wilderness.

Pliny, with his sense for military precision, came still closer to the original when he wrote:

> The Orsaean Indians hunt an exceedingly wild beast called monoceros, which has a stag's head, an elephant's feet, and a boar's tail. The rest of the body is like that of a horse. It makes a deep lowing noise, and one black horn two cubits long projects from the middle of the forehead. This animal, they say, cannot be taken alive.

We are apt to smile when we read this description nowadays. But if compared word for word with a good photograph of an Indian rhinoceros it is not so bad at all. It is the words chosen that make us smile; the facts are not so wrong.

The climax of all unicorn descriptions was reached by Julius Solinus in his *Polyhistoria.* This Roman found a worthy translator in Arthur Golding (1587), who wrote:

> But the cruellest is the Unicorne, a monster that belloweth horrible, bodyed like a horse, footed like an elephant, tayled like a Swyne, and headed like a Stagge. His horn sticketh out of the midds of hys forehead, of a wonderful brightness about foure foote long, so sharp, that whatsoever he pusheth at, he striketh it through easily. He is never caught alive; kylled he may be, but taken he cannot bee.

Dr. Odell Shepard, who has traced the literary history of the unicorn in his delightful book *The Lore of the Unicorn,* remarks of this passage: "Whatever rhetoric can do to make the unicorn impressive Solinus has done." And, one may add, Golding did everything to preserve the flavor of the original Latin thunder.[1]

Soon after Solinus the history of the unicorn "goes wild." The Semitic literature delighted in exaggerating its size to impossible dimensions. The Arabs said that the unicorn loved to pierce elephants with its horn (later, in medieval Europe similar stories made their appearance, sometimes about the unicorn, sometimes about the rhinoceros), but that it never succeeded in shaking the carcass from its horn.

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[1] It is impossible to resist the temptation to quote this passage in the original:
Atrocissimum est Monoceros, monstrum mugitu horrendo, equino corpore, elephanti pedibus, cauda suilla, capite cervino, cornu e media fronte protenditur splendore mirifico ad longitudinem pedum quatuor, ita tamen, ut quidquid impetat, facile ictu ejus perforetur. Vivus non venit in hominum potestatem, et interimi quidem potest, capi non potest.

Thus, after three or four dead elephants had accumulated on its horn the unicorn lost its mobility and fell prey to the roc. The Jews competed with the Arabs in unicorn tales worthy of Baron von Münchhausen or Paul Bunyan and quoted the Talmud about its size, which was so incredible that Noah could not find room for it in the Ark, so that it had to swim for the entire duration of the Flood and could only occasionally rest the tip of its horn on the Ark.

Travelers to those magic countries in the East did not forget to look for the unicorn. And if they really found it—that is, the real "unicorn," the rhinoceros—they were often bitterly disappointed. Instead of a glorious and colorful wonder animal, they saw a rather ugly monster. Marco Polo could not conceal his disappointment when he wrote:

> They have wild elephants, and great numbers of unicorns, hardly smaller than elephants in size. Their hair is like that of a buffalo, and their feet like those of an elephant. In the middle of the forehead they have a very large black horn. You must know that they do not wound with their horn but only with their tongue and their knees. For on the tongue they have very long sharp spines, so that when they become furious against someone, they throw him down, and crush him under their knees, wounding him with their tongue. Their head is like that of a wild boar, and is always carried bent to the ground. They delight in living in mire and mud. It is a hideous beast to look at, and in no way like what we think and say in our countries, namely a beast that lets itself be taken in the lap of a virgin. Indeed, I assure you that it is quite the opposite of what we say it is.

Small wonder that such a disappointing sight usually caused rejection of the rhinoceros as the unicorn. This elephantine and not at all beautiful monster could not be the same as the glamorous unicorn! They had to be different animals—both with one horn, it was true, but otherwise as different as night and day. The rhinoceros had to be overcome by brute strength while the unicorn yielded to much more subtle measures.

This was the strangest and most curious development in unicorn lore. It was Christian mythology that had slowly but surely made the unicorn a slave to virgins. According to ancient tradition it could not be captured, but the new Christian legend found an exception. Yes, it could be captured, but not by a man. A virgin must go into the forest where the unicorn roams and wait there patiently. Then, after a little

while, the unicorn would come and put its horn into the lap of the virgin, lose its power and fierceness, and fall asleep. The hunters who had hidden themselves in trees would then come and take the royal beast prisoner. This Christian myth has, strangely enough, baffled learned commentators for centuries, and the more learned and more bigoted was the commentator the more he was baffled. Actually, the explanation is very simple; one has only to know that the unicorn meanwhile had become the symbol of royal power, which happens to be the same as manly power.

While this legend was still being told, the lore of the unicorn had followed another trend—a trend that centered more upon the alicorn than upon the animal itself. From the days of Ctesias the alicorn was believed to be a powerful antidote against any kind of poisoning, whether accidental or deliberate. Naturally many people, especially those in power, liked to possess this antidote since they were most frequently the ones against whom such crimes were directed. Naturally also its price climbed according to the demand, until the famous mark "weight for weight, alicorn for gold" was reached. And, still more naturally, alicorn was faked.

Rhinoceros horn might be passed off for "true" alicorn. There were also horns of blackbucks and other antelopes on the market. In Northern Europe *unicornum verum* and *unicornum falsum* were strictly distinguished. The former, "true alicorn," was usually found in the earth—actually mammoth tusks—while the false alicorn came in quantities from the North—actually the tusk of the narwhal, a marine mammal. In fact, practically all the unicorn pictures in ancient books show a horn evidently based on the tusk of the male narwhal. That the female does not possess this tusk makes its function seem very mysterious. If it were a weapon or useful as a tool, both sexes would show it. It seems really to be as much an ornament in nature as it became on the king's table (to touch food and drink with) or in the apothecary's shop.

A few skeptical Italians during the Renaissance were the first to attack the supposed medical virtue of alicorn. They fought against every pharmacist who had one chained to the counter in his store. The apothecary was very proud of his alicorn, but not too proud, of course,

to refuse a profitable sale, for the popular belief was still strong. Even Konrad Gesner (remember, he was Zürich's municipal physician) could not help but prescribe alicorn if his patients insisted. But he made the sly remark that in such a case he "neither forgot nor neglected" to prescribe other medicines simultaneously. It took a very long time for alicorn finally to disappear from the stock lists of pharmacies; the last of the "must" lists issued for London pharmacies that contain alicorn was printed in 1741.

All this time the belief in the animal had slowly faded. Even those who defended alicorn for its medical value (and for their profit) conceded that the animal from which those horns came might be almost or even completely extinct. One can almost see the apothecary foretelling the extinction of mankind very soon as a consequence. Fortunately he himself still had one but, of course, he was now more reluctant to part with it than ever.

The death blow to the unicorn—as far as the scientific world was concerned—fell in 1827 when Baron Cuvier declared that a single-horned animal with a cloven hoof was impossible, for such an animal would have a divided frontal bone and no horn could possibly grow upon the division. The existence of the rhinoceros does not contradict Cuvier, because the horn of the rhinoceros is not—as I should have stated earlier—a true horn. A true horn, like that of a cow, consists of a horny sheath covering a bony core which is connected with the bones of the skull. Now the "horn" of the rhinoceros does not show such a division into sheath and core; it consists, so to speak, of a bundle of immensely tough bristles glued together. Such a pseudo-horn need not follow Cuvier's rule.

It may also be added that Cuvier's later disciples, the paleontologists of around the year 1900, began to believe that they had successfully discovered the original unicorn. In Russia and in Siberia bones and skulls of an extinct distant relative of the rhinoceros were discovered. This animal, *Elasmotherium sibiricum,* seemed to resemble the ancient reports even more than does the living rhinoceros. It was noticeably larger than the largest Indian rhinoceros, its horn was much longer and was actually situated in the middle of the forehead of the animal. But after the first excitement had subsided, most scientists abandoned

the idea that *Elasmotherium* had anything to do with the unicorn legend. However, as Melchior Neumayr wrote in his *History of the Earth:* it is possible that in Siberia man and *Elasmotherium* actually lived together and that *Elasmotherium* was exterminated by man; at least one may explain in this way the ancient songs of the Tunguses, which tell that formerly there lived in their country a kind of terrible black ox of gigantic size and with only one horn in the middle of the forehead, so large that an entire sled was needed for the transportation of this horn alone.

At this point the story of the unicorn appeared to have reached its end. All the possibilities seemed to have been exhausted, all the many and curious beliefs seemed to have been explained, at least as far as that was possible. For about thirty years there was an almost unbroken silence about the unicorn. Little was written of it, and when in 1930 Odell Shepard's great work on the unicorn appeared, this seemed to be the final contribution to a long and glorious history, the "last" work which collected all the facts and traced the story of the strange lore through the literatures of at least a dozen nations.

But three years later, in March 1933, an American biologist, Dr. W. Franklin Dove of the University of Maine, performed a simple operation on a day-old male Ayrshire calf, an operation which looked as if it were the direct result of a study of Dr. Shepard's work, though this was not so. Dr. Shepard had related in his book that unicorned sheep exist in Nepal and are even sent to Europe on occasion. It was known that these unicorned sheep were being produced artificially, but the method and reason for such treatment were not clear. There were also reports that the Kaffirs sometimes produced unicorned cattle, and the Dinkas in Africa were also said "not only to manipulate the horns of their cattle as the Kaffirs do but to use this practice as a means of marking the leaders of their herds."

It seems possible, therefore, that what I may call the unicorn idea, the notion that one-horned animals exist in nature, arose from the custom of uniting the horns of various domestic animals by a process which is still in use but still mysterious to the civilized world. Here may be the explanation of the one-horned cows and bulls that Aelian says were to be found

in Ethiopia and of the unicorned cattle reported by Pliny as living in the land of the Moors. The cows with single horns bending backward and a span long seen by Vartoman at Zeila in Ethiopia may have been of this sort. The one-horned ram's head sent to Pericles by his farm hands may have been that of the leader of their flock, and so a perfect symbol of that leadership in Athens which, according to Plutarch's interpretation, they wished to prophesy for their master. Finally, the mysterious one-horned ox mentioned three times over in the Talmud as Adam's sacrifice to Jehovah may have been the most precious thing that Adam possessed, the leader of his herd of cattle.[1]

Dr. Dove did not know all this when he planned his operation. But he suspected that Cuvier's statement about the impossibility of a cloven-hoofed unicorn might not be correct always and under any condition. Cuvier's contention had been that the bony core of a true horn could not grow in the middle of the forehead of such an animal because the frontal bones are joined by a suture. Evidently a protuberance could not be expected to grow from such a spot.

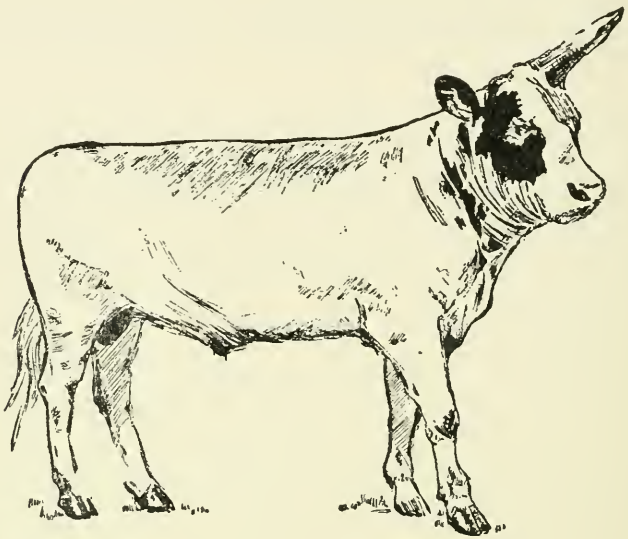
Cuvier was right to a certain extent. The fact is that horn cores do not grow from this spot under normal circumstances. But he was wrong to assert that they could not grow there. Dr. Dove found, and established it experimentally, that the bony horn cores of cattle are *not* outgrowths of the frontal bones, as Cuvier had believed, but that they are formed from horn buds which originate in the soft tissue covering the frontal bones. In other words, the bony horn cores do not grow *from* the skull but *upon* the skull and do not fuse with the frontal bones until a certain stage of development is attained.

Anatomical conditions being thus, it is of course possible to transplant the horn buds. The operation performed by Dr. Dove did just that. It consisted of cutting the two horn buds, trimming them flat at their point of contact, and placing them together over the "seam" of the frontal bones. It was expected that they would grow into a single horn spike, sheathed by a single horn, and that this horn would grow to the skull of the animal in exactly the place always reported as the point from which the horn of the unicorn grew.

The experiment was a complete success; in some respects it was even

[1] Odell Shepard, *The Lore of the Unicorn* (Boston: Houghton Mifflin, 1930), p. 229.

more successful than anyone had dared to dream. Ordinarily this race of cattle has curved horns, but the horn of the artificial unicorn grew almost perfectly straight. Only near its tip did it curve slightly upward. Furthermore, this single horn that covered the single bony spike (which was solidly attached to the frontal bones in spite of the suture)



Unicorned bull: the result of the operation performed by Dr. Franklin Dove of Orono, Maine, on the horn buds of a bull calf of domesticated cattle

(Drawn from a photograph)

was grayish-white at the base and tipped with black. If the calf had been a female, the horn would have been tipped with red, according to Dr. Dove; exactly the colors of the ancient descriptions that were so puzzling to later commentators.

The most surprising result, however, was the behavior of this animal. As Dr. Dove wrote:

True in spirit as in horn to his prototype he is conscious of peculiar power. Although he is an animal with the hereditary potentialities for two horns, he recognizes the power of a single horn which he uses as a prow

to pass under fences and barriers in his path, or as a forward thrusting bayonet in his attacks. And, to invert the beatitude, his ability to inherit the earth gives him the virtues of meekness. Consciousness of power makes him docile.

If these sentences were not written in modern English, but in Latin, and if they were not printed in a modern scientific journal of the year 1936 but in a book of about the year 1550, one would probably select them as the shortest and most typical of all the descriptions of the fabulous monster.

The ancient descriptions usually fit the rhinoceros better than the unicorned ox. But at the same time the ancient authors were often emphatic in asserting that unicorn and rhinoceros were not the same. That they afterwards proceeded to describe the one in terms fitting only the other is amusing, but excusable. One may be permitted to think that there have always been families that knew and practiced the secret of producing unicorns. One may also amuse oneself by trying to imagine the fanciful tales about long and most perilous voyages, invented and told to conceal the real origin of the high-priced animals. In short, one knows most of the story of the unicorn if one knows about the possibility of producing unicorned oxen by a simple operation and if one remembers that the single horn is not only the symbol of the leader of the herd but actually *makes* the leader of the herd.

There is only one question left open for discussion. Do we have reason to assume that the ancients, the Kaffirs, the Dinkas, and the natives of Nepal knew and know today how to perform this operation and that they have the ability to perform it? It could be argued that single-horned domestic animals are known to have been produced sometimes by these people and that the operation itself is simple. But there is not even a reason for any argument because Pliny gave the recipe for the operation. In the eleventh book of his *Natural History* one may read in the course of the discussion of the horns of oxen: "Incisions are twisted in several directions so that four horns sprout on the head."[1] Though this concerns multi-horned animals it applies to uni-

[1] The original reads: ". . . *atque incisa nascentium in diversas partes torqueantur, ut singulis capitibus quarterna fiant.*"

corns as well. Probably Pliny did not know this, else he would have made mention of it. But it is very likely that there were people who knew that what can produce four horns can also make a unicorn. And so they produced artificial unicorns, the leaders of the herds, formidable with their straight horns, "white at the base and tipped with scarlet."

2: "There Were Giants in Those Days"

IT WAS on May 9, 1944, that Dr. Franz Weidenreich of the American Museum of Natural History in New York City read a paper before the American Ethnological Society which not only threw the assembly into a polite uproar but is also apt to be quoted under the heading of "first report" in scientific books as long as scientific books are written. What Dr. Weidenreich told to the assembled ethnologists amounts to nothing less than a scientific corroboration of that single but oft-quoted passage in the Bible which says that "There were giants in those days."

"Those days" means the early and middle Pleistocene, or about the interval from 750,000 B.C. to 400,000 B.C. As to the locality, we know that giants lived in Java and in Southeastern China, and we may presume that they could also be found elsewhere in Asia. The evidence, so far, rests only on a few finds which are unfortunately very fragmentary and will remain so until systematic paleontological and anthropological research can be resumed in the Far East and in the Indonesian archipelago.

The story of that discovery really began some sixty years ago with the conviction, or almost *idée fixe,* of a Dutch doctor that he had figured out where the ancestors of Man could be found. That doctor's name was Eugène Dubois, and he went to Indonesia in 1883, soon after finishing his medical studies in Holland. His reasoning was this: A scientist by the name of Richard Lydekker had discovered the re-

mains of a large anthropoid ape in India in what is known in paleontological circles as the Siwalik fauna. The name is purely geographical, having to do with the native name for a mountain chain in the territory where the discoveries were made. Now, it was known that this so-called Siwalik fauna had also existed on Java. Dr. Dubois concluded that Java might then have been the place where Man developed from forms which we would call "apes" (of course none of the apes of today) because Java had not been touched by the Ice Age. It was pretty reasoning, and while we now know why the logic was poor, Dr. Dubois happened to be successful in the end, at least to the extent of pointing out a site of very ancient Man.

Dr. Dubois entered the Colonial Service of the Royal Dutch Army as a physician and succeeded in interesting his superiors in his ideas. In accordance with a tradition that had been started at a time when all the Dutch trade in the East Indies was still in the hands of a (chartered) private company, Dr. Dubois was given a free hand to do scientific research. In fact he not only got a free hand, but government backing. At first he tried Sumatra, but he turned up nothing more startling than a few teeth of orang-utan, which is now extinct in Sumatra, but lives on Borneo. But then, encouraged by the find of an otherwise not too remarkable fossil skull on Java, he turned to Java. And near a place called Trinil—and also, unflatteringly, called the "Hell of Java"—Dubois found rich fossil beds. The abundance of fossils was easily explained: then as now one of the numerous volcanoes of Java would have an "uitbarsting," as the Dutch call it, and bury large herds of animals under hot mud and volcanic ashes. Dubois himself and some other investigators even blamed one specific volcano in the neighborhood, Gunung Gelunggung (its very name sounds like subterranean rumbling) with having caused the local catastrophes.

In October 1891 Dr. Dubois found a very low skullcap some distance from Ngawi, near Trinil, on the banks of the Solo River. At first he thought it was the skullcap of a chimpanzee, possibly the same kind that Lydekker had dug from the Siwalik foothills in India. But in August of the following year—the site could be worked only during the dry season, when the water level was low—he found, some

fifty feet from the place of the skullcap, a human femur. Dubois concluded that these two finds belonged together, had once belonged to the same individual (some features of the femur caused the guess that it had been a female) and that this was the transitional form between ape-ancestors and man-ancestors. Charles Darwin had prophesied such a form, Ernst Haeckel had even named it (as for the principles involved, see page 288). Haeckel's name, or label, for the hypothetical form which was still to be discovered had been "Apeman" or *Pithecanthropus*. Dr. Dubois could see from his femur that his form had had an erect walk like modern men, and named it *Pithecanthropus erectus*.

One cannot quite imagine nowadays how enormous this announcement was. Small wonder that several parties formed quickly, even before Dubois had published a complete description of his find—which, it must be admitted, took him a rather long time, close to three decades. One party accepted Dubois' statement. Another agreed generally but said it was merely an exceedingly primitive man, with a brain capacity exactly halfway between the smallest-brained normal people of today and the largest known ape brain. A third group stated that it was merely an especially brainy ape, and a final group insisted that the skull fragment and the femur did not belong together at all, and that the femur was human while the skullcap was that of an ape. It is worth remembering in this connection that many of those who spoke of the ape nature of the skullcap had only a decade earlier denied that there were fossil monkeys or apes at all. Apparently they found it easier, when confronted with facts, to admit the existence of fossil apes than that of a fossil intermediate form. So now they took the position: a fossil ape, yes—a very intelligent ape, yes—an unknown form, of course—but, after all, merely an ape!

This discussion as a whole consumed lots of paper, printer's ink, and lantern slides, but it did not come to any real conclusion. This was not too surprising: one single skull, and that highly fragmentary, was really not enough material on which to decide such a weighty problem. All parties joined in a cry for more Trinil skulls, each one hoping that that would settle the question. "When we have one com-

plete skull of that type, and preferably a whole skeleton, even you, my dear colleague, will have to admit that *my* interpretation of the Dubois skull was correct."

A German by the name of Selenka went to Java with his wife to dig up more skulls. He found many interesting and even valuable fossils, but not a trace of *Pithecanthropus*. After his death his wife tried to get another expedition together—there just *had* to be more skulls in the ground—but failed to raise the necessary cash, possibly because the First World War intervened.

Then, after the war, news came from entirely unexpected quarters. One Dr. Davidson Black turned up with ancient skulls from the vicinity of Peking. That was in 1929, and the skulls proved that a very primitive type of humans had inhabited the vicinity of Peking early in the Ice Age. These skulls were more complete than the Dubois skullcap by far and could be examined in detail. They were most decidedly not apes, the thickness of the bones alone proved that. It is, as may be remarked at this point, an interesting fact that the bones in human skulls are much thicker and heavier than those of ape skulls; even the skull of the gigantic gorilla is no exception. It may look thicker in places, but then there are sinuses present, the actual bone thickness is less, most especially in those parts which protect the brain. When it comes to that, man is the true "bonehead."

Those Peking skulls were human. But, no doubt, a more primitive type of humans than had ever been found before. In describing them, Dr. Black pointed to numerous similarities with the Dubois skull. It became abundantly clear that *Sinanthropus* from Peking and *Pithecanthropus* from Java were closely related, possibly even identical.

Doctor Dubois, who meanwhile had turned hermit in a strange way and had become increasingly difficult and more and more—well, "morose" might be the best term for it—was the only one who did not rejoice. Everybody else was quite happy with Dr. Black's discovery. It not only established *Pithecanthropus* as an early hominid (incidentally solving the old problem whether femur and skull belonged together; they obviously did) but it also showed that this form had lived over a large area, possibly all of southeastern Asia and most of the accessible islands of the Insulinde archipelago of which Java is

a part. Doctor Dubois himself suddenly turned around and claimed that his skull did belong to an ape after all, more specifically to an otherwise unknown large gibbon. But nobody paid attention to Dr. Dubois any more.

As if Dr. Black's work in China had broken the spell, Java began to produce more *Pithecanthropus* material; the name of the man responsible for the whole new development of the question is again that of a Dutch scientist: Dr. G. H. R. von Koenigswald. The new series began with a fragment of a jaw in 1937. There was a fragment of a very primitive human jawbone known for quite some time, called the Heidelberg jaw, although the actual place of discovery is far closer to a place called Mauer than to Heidelberg. But naturally the unknown Mauer could not compete with the famous Heidelberg when it came to naming it. Needless to say that the new jaw from Java was compared with the Heidelberg jaw, about which there are extensive publications. Like the German jaw, the new Javanese jaw was found to be indubitably human. Also very primitive. But it was bigger than the Heidelberg jaw.

One year after the jaw came another skullcap from Sangiran on Java. It was somewhat more complete than the Dubois skullcap, but it was not a complete skull, the whole face was missing. With it, of course, the jaws. It was logical to think that the Java jaw belonged to *Pithecanthropus,* except that it did not fit. It was too big. The Heidelberg jaw was much closer in size. The Java jaw had to be something else.

In January 1939 Dr. von Koenigswald came to Peking, where Dr. Franz Weidenreich was working at that time, and brought another jaw with him. It had well-preserved teeth, no doubt human teeth. But it also showed a gap between the front teeth and the canines which had always been considered typical for the anthropoids and was therefore called the "simian gap." It was an upper jaw; both the Heidelberg jaw and the Java jaw—which was still tentatively spoken of as *"Pithecanthropus* jaw"—were lower jaws. In spite of the simian gap it was human, but again very large.

In examining their specimen, both scientists discovered that the breakage was relatively fresh, fresh enough for hopes that the other

parts might be in the ground not too far from the place where it was found. Instructions were sent to Java and about four weeks later the so-called unknown portions arrived in Peking. These were of a skull which had been badly crushed twice: once before fossilization (its owner may still have been alive at the instant of crushing) and then once again after fossilization. What was left was most of the brain case, sections of the facial structure and, of course, the upper jaw. Later, after Dr. Weidenreich had come to New York, the whole skull was reconstructed and the lower jaw fitted to it.

Now this was at long last a reasonably complete *Pithecanthropus* skull from Java. It was a very pleasing situation indeed, generally speaking. First Dr. Black had brought those *Sinanthropus* skulls to light and proved that they were human. Because of the many and close similarities, Dr. Dubois' original *Pithecanthropus* must be human too. Now Dr. von Koenigswald had unearthed an almost complete *Pithecanthropus* skull from what could be considered the same river from which Dr. Dubois' first specimen had come. It was, strictly speaking, a tributary of the Solo River, but one might as well say that the Solo has two springs, the naming was unimportant. At any event, the same river system. And that skull was human too.

But there was something fundamentally wrong!

The new skull was *Pithecanthropus,* but at the same time it wasn't. It was too large. Doctors von Koenigswald and Weidenreich looked at it literally from all angles. Yes, hm, the thickening of the bones here and the general enlargement all over and that greater heaviness there were all things which also distinguish a male from a female skull. Maybe this was just the skull of a big male specimen. In which case the first skullcap (Dubois, Trinil, 1891) and the second skullcap (von Koenigswald, Sangiran, 1938), being both smaller and very similar to each other, had both belonged to females.

If no other fragments had been found, that would have settled the question, and people would have been more convinced than ever before that the femur found by Dubois actually belonged to the individual of which he found the skull. That femur indicated female; now the skulls were both "recognized" as female too, simply because the bigger male had been found. And when lecturing about this,

most lecturers would have paused for a moment in order to explain that something like that had happened before. One of the enormous biped dinosaurs of the Cretaceous Period, *Iguanodon,* had become known slowly and piecemeal: first footprints, then teeth, then skull fragments, then a foot skeleton, single bones, and, at long last, a find of two dozen of them, complete. Two types were recognized, one called *Iguanodon Mantelli* in honor of the geologist Mantell, the other *Iguanodon bernissartensis* after the place of the big find, Bernissart in Belgium. Later examination proved that they were just the males and females of the same animal.

In the case of *Pithecanthropus,* things once more went "wrong." To begin with, Dr. Weidenreich set out, assisted by Otto Falkenbach, to reconstruct the "male" skull. When he was finished he felt dissatisfied. That was not just a bigger male, that was a different type. Reluctantly he opened up the question of the sex of the Dubois skull once more; he was no longer sure that the two smaller skulls were female. Because this was maybe still a male, but a male of a different type, he decided to call it *Pithecanthropus robustus.*

Meanwhile Dr. von Koenigswald had found two more jaws at Sangiran, both fragmentary. The first cannot be classified, because the teeth are either missing or so much worn down that nobody can tell whether they are man or ape. But, once more, the second was undoubtedly human. Also, again, it was bigger, too big this time even for *Pithecanthropus robustus.* Now they could have repeated their earlier idea and said, ahem, so this is now the male of *robustus,* the first one was merely a small female. But Dr. von Koenigswald had realized that there must have been many human types. He called the human to which this new and bigger jaw had once belonged the *Meganthropus palaeojavanicus,* the "big man from old Java."

Depending on your whim, you can translate the Greek root word *megas* in various ways. I translated it just now as "big," Dr. Weidenreich translates it as "giant." A professor of Greek may shake his head a little about this, but the factual reasons are good: "We shall not fail," said Dr. Weidenreich in that lecture, "in estimating that *Meganthropus* reached the size, stoutness, and strength of a big male gorilla."

A point of doubt was permissible. There have always been individual "giants," pathological specimens with malfunctioning glands, usually weak and sickly not in spite of but because of their size. Their lower jaws are especially large if the pituitary gland is unbalanced, and that has even received the special name of "acromegalic giantism." What proof was there that the jaw fragment found was not such a pathological case? Was it possible that the suspected "giant" was merely a sick acromegalic giant?

It would have been a reasonable question, but it could not even come up, because Dr. Weidenreich looked for such a possibility himself. Now, in an acromegalic giant the thickening is pronounced only in the lower portions, accompanied by an enormously prominent chin. The jaw of *Meganthropus* is thick all the way through and it has no chin at all. Furthermore, the teeth of a pathological case of giantism are of normal human size. The teeth of *Meganthropus* are of the proper size in relation to the bone.

There is nothing pathological about that jaw. It is just big. It is the jaw of a man, or rather of a savage, of the size and strength of a large male gorilla. But as intelligent as a man.

It was a frightening idea indeed.

But it was not the end of those discoveries yet.

And now we have to go into Chinese medical lore.

A Chinese pharmacy looks, generally speaking, rather like our own of a hundred years ago. It contains herbs and herb extracts, salves and seeds. But there are also many drawers full of *lung-tchih* and *lung-koo,* dragon bones and dragon teeth. They are finely ground and go into pills and potions, and if you are to trust the apothecary there is no such thing as a sickness or disease which will not be cured by one of the *lung-tchih* or *lung-koo.* Ever since scientists learned of this they have rummaged through these drawers whenever there was an opportunity to do so, and a fair amount of fossil bones and teeth in our collections and museums were not found but rather purchased in an apothecary's shop in Inner China. The dragon bones and teeth are actually fossils from the interior—the precise sources are kept secret by the Chinese—and they are usually from Tertiary mammals.

Dr. von Koenigswald, like any other paleontologist, had known

about the Chinese "drugstore fauna" since his freshman days. And he had rummaged through such drawers too whenever there was an opportunity. One of his finds was a big human tooth. Another tooth followed a while later. And then a third. While the roots are mostly missing, the crowns are well enough preserved to study them. And it is just the crowns which enable an expert to say whether these teeth are human or ape.

They are human and their volume is *six times* that of the corresponding molars of modern man, or twice that of the volume of the corresponding molars of a big gorilla. Dr. von Koenigswald had not dared at first to call these gigantic crowns human, and had spoken of *Gigantopithecus,* "giant ape." But Dr. Weidenreich established that they are not ape, that their structure agrees, down to minute detail, with that of human teeth. It should be *Gigantanthropus,* "giant man."

If the teeth alone are accepted as an indication of the total size—as they well may be in this particular case—the size of *Gigantanthropus* was *twice that of a big male gorilla!*

There *were* giants in those days. . . .

The second series of *Pithecanthropus* discoveries was terminated by the Second World War. Dr. von Koenigswald became a prisoner of war of the Japanese, since he held a commission in the Royal Dutch Army. Luckily, as he explained after his arrival in New York in 1946, the Japanese were so sure that Java would belong to them after the war that they did not disturb Dr. von Koenigswald's private museum, they only sent one of the *Pithecanthropus* skulls to Hirohito, who has returned it in the meantime. The big *Gigantanthropus* teeth and the other unique pieces had been smuggled out, and Dr. Weidenreich had published the story of Dr. von Koenigswald's finds and researches in this country in the meantime, since nobody knew what had happened to the discoverer. In fact, many scientists were quite worried about Dr. von Koenigswald's fate. Actually, he spent the war in Japanese prison camps on Java as a translator.

But now let's turn from the actual giants of the past to the giants of history. Once you look for them specifically you find to your sur-

prise that history is full of giants. But they were not real, they were imitation giants, borne out by spurious evidence. I am not speaking of deliberate hoaxes like the so-called Cardiff Giant, which was a sculpture in stone, somewhat "aged" in the ground and then exhibited for money until scientists exposed the fraud. I am speaking of honest misunderstandings.

One of the classical cases of this kind can be found in an old book, Merian's *Theatrum Europaeum* of 1647. There is a chapter devoted to the Giant of Krems (a city in Austria) and it begins (translated) as follows:

> In the year 1645, around St. Martin's day, when the Swedes occupied the city of Crembs (Krems), those people built, in addition to other fortifications, a stronghold up on the mountain, near the old round tower, but found that rainwater would harm the work: therefore they dug a ditch to carry away such water as it might come. It then happened that they, in that ditch, about three or four cubits below the surface, found in a soil that was yellow but somewhat blackened by the putrefaction of flesh, a gigantic large giant's body, of which (while the work progressed and before it had been recognized as a body) the head and some limbs had been destroyed because everything was soft and rotten with age and decay, but still many parts remained that were looked at by learned and experienced men and were declared human limbs, these parts were salvaged and sent to Sweden and Poland. . . . A few parts, among them a tooth weighing some five pounds, were kept in Crembs, and could be seen in the *Oratorio* of the new church which the Jesuits had built up on the mountain. It is also reported that two other giants' bodies, although somewhat smaller, had been found, but since the digging was pursued only as far as required by the necessity of the fortifications, said bodies were left remaining in the depth of the soil. . . .

Fortunately the author of the book, Merian, pictured the five-pound tooth, and because of that there can be not the slightest doubt that the Giant of Krems was actually a specimen of *Elephas primigenius,* the woolly mammoth.

A very similar discovery had taken place about a century earlier near Lucerne in Switzerland and hence goes under the name of the case of the Swiss Giant or the Giant of Lucerne. It had been found in 1577 under the roots of an old oak tree, finally felled by a storm. The local authorities, civil and Church, wondered whether the incom-

plete remains were animal or human and whether they, in the latter case, were deserving of a Christian burial, and called in a famous man of their day, one Dr. Felix Platter of Basle. Dr. Platter viewed the remains and pronounced gravely that they had come from a giant nineteen feet tall. They were placed in the town hall, waiting to be seen by a man who really knew anatomy. This happened around 1800 when Prof. Dr. J. F. Blumenbach of Göttingen paid a visit to Lucerne. One glance was enough for Blumenbach, and the City Council had to learn and digest the fact that there had once been a member of the elephant tribe called *Elephas primigenius.*

But Blumenbach restricted himself to exposing the Swiss Giant, he had neither the time nor the inclination to go in for a general attack on all similar giants. That was a job which fell to Cuvier.

Cuvier's brilliant battle against the giants was carried on in the French Academy, which had been the battleground for a prolonged and bitter controversy over the "bones of King Teutobochus" ever since their discovery on a plain in the Dauphiné. From olden times this plain had been known as *le champs des géants,* the field of giants, for gigantic bones had been found there repeatedly. On January 11, 1613, someone stumbled over a fairly complete skeleton of *Dinotherium,* an extinct distant relative of the elephant, the bones of which are still in Paris. A "surgeon" named Mazurier excavated the bones and claimed later that he had found them in a stone grave thirty feet long, inscribed with the name of King Teutobochus. Evidently Mazurier's arguments did not sound very convincing, because a number of learned members of the Academy doubted the authenticity of the find. But they did not say that the bones were in reality the bones of a large animal; they only wondered whether they were actual bones or merely a mineral "freak of nature." It was Cuvier who could not only prove that they were bones, but could also say what kind of bones they were. Ever since 1824, when his *Recherches sur les ossements fossiles* appeared, no one has seriously talked of historical giants again.

A great number of similar legends have definitely been traced to remains of large extinct animals. In a number of cases the bones that caused the legends were no longer available, but the stories al-

ways pointed to the kind of places in which geologists would expect to find such bones.

To show that this tendency did not constitute a monopoly of Bible-reading medieval Europe I would like to quote just one more case, this time from this side of the Atlantic Ocean. It can be found in the "extracts from the Itineraries of Ezra Stiles" (Yale University Press, 1916) and is in the form of an entry in the diary of the Rev. Ezra Stiles, D.D., LL.D., President of Yale College, who died in 1795. The entry is dated "June 1764" and reads, maintaining all the vagaries of Dr. Stiles' spelling:

> About 1705 Mr. Taylor wrote a poetic Accot. of the Gyant found then at Claveric below Albany—and says that about fourty years before (or perh. 1666) he heard a Story of an Ind. Giant of incredible Magnitude & disbelieved it till he saw the Teeth, which he weighed, one above Two pounds & another full *five pounds.* He was told by the Dutchmen that the Grave or Extent of the Skeleton was *Twenty-five paces,* & they dug up a Thigh bone measuring seventeen feet long & a knee pan a foot Diam. The Ind. has often told the Dutch of this Giant who they said was as tall as the Pine Tree and died Two hundred & fourty years before.
>
> The Thigh Bone was found & took up June, 1705, so he died about 1465.—A Tooth weighed four pound & three Quarters. Grandfather Taylor says: "Two other Teeth after were took up and were Weighed by myself in my house in Westfield; one weighed five pounds, it had three furrows on the Top & was as hard as a stone; the other Two & one ounce. These Bones the Indians about Fort Albany flocked to see, upbraided the Dutch of Incredulity for not believing them who told them about 40 years before that Time they had an Indian as tall as the tall pine Trees, that would hunt Bears till they were treed & then take them with his hands, & wade into Water 12 or 14 foot deep & catch Sturgeons 3 or 4 or 5 at a Time & broil & eat them."

At another place Dr. Stiles quoted from an entry in Taylor's Diary, of 1705, regarding those teeth. It was said there that the teeth "looked like dull Olivant (ivory)" and also that the Indians had always asserted that the giant was "peaceful and would not hurt the little Indians." The description of the teeth, incidentally, poor as it is, indicates that they came from one of the American mastodons.

The tendency to regard any large bones as giant's bones was widespread, as can be seen from these examples, and there can be no doubt

that the Biblical reference was responsible for that in Christian countries. But that it was not the Biblical reference alone is proved by the most classical story of them all, the *Odyssey*.

After succeeding in breaking away from the land of the Lotus Eaters (now identified as the island of Jerba in the Gulf of Gabes on the North African coast), Odysseus and his companions sail for an unspecified but apparently short time:

> Unto the Land of the Kyklops, a race overbearing and lawless,
> Soon we arrived. Here, trusting the favour of powers immortal,
> None with his hands e'er planteth a plant or tills with the ploughshare,
> Yet untilled and unplanted, behold, all groweth in plenty,
> Wheat and barley and vine; and the vine's luxuriant clusters
> Bear rich juice of the grape that the rain of the heaven does nourish.
> Neither assemblies for council they have nor laws and traditions,
> Dwelling apart on the crests of the highest mountains the Kyklops
> Hollow caverns inhabit. . . .[1]

Then follows the well-known adventure with Polyphemus, the son of Poseidon, mightiest of all the Cyclopes (or, in Greek, *kyklops*). Odysseus and his men, looking around on the luxuriant isle, enter a large cave. There are signs of human activity, but nobody is in sight. But at dusk the Cyclops appears, a gigantic figure with only one large round eye (*kyklops* also means "round-eyed" in Greek) in the middle of the forehead. I might mention here that Homer had his little joke with the names of these characters here as elsewhere in the *Odyssey: Polyphemus* means "the much talked-about"—such stories must have been daily fare in the harbor taverns where sailors met and drank and talked.

Polyphemus eats two of the men and then settles down to sleep, closing the entrance with a boulder too large for human hands to move. The next morning he again eats two of the warriors and then leaves, closing the cave behind him. Odysseus and his men sit around gloomily, thinking of means to overpower the monster. At night Odysseus greets Polyphemus with heavy Greek wine and, being asked about his name in the ensuing conversation, tells Polyphemus that "Nobody called me my mother and nothing but Nobody call

[1] *Homer's Odyssey*, H. B. Cotterill, trans. (London: Harrap, 1911), IX, 106-114.

me all my companions" . . . an old ruse often found in ancient literature. When the giant is moaning in drunken sleep Odysseus and his men heat a pole in the fire and jab it into the single eye. The giant shouts for help, but when other Cyclopes, assembling outside the cave, hear him yell that "Nobody tries to kill me" they depart again, advising him to pray to his mighty and immortal father. Odysseus and his men escape with the flock of sheep the next morning.

Safely aboard his vessel, Odysseus cannot resist to shout his real name to the blinded monster. Polyphemus tries to call him back, but Odysseus very wisely distrusts the pleasant promises and urges his companions to row harder.

> Thereat, with a heart more maddened to fury,
> Breaking a peak clean off from a huge high mountain he hurled it.
> Down on the water it fell . . . .[1]

Tradition almost as old as the *Odyssey* itself has it that the island of Polyphemus is Sicily, and most commentators saw a perfect description of the giant in the lines 190-193, Book IX:

> Yea and a monstrous marvel was he—not fashioned in seeming
> Like to a mortal that liveth on bread but the peak of a mountain
> Covered with forests and standing alone, o'ertopping the others.

It was Vergil who spoke of *Aetnaeos Cyclopas,* indicating that he took the Cyclops Polyphemus to be a personification of Mount Aetna in Sicily. Many of the other features agree well with this explanation. The large *round* eye might well be the crater, the roaring shouting of the giant and the throwing of mountain peaks also speaks for a volcano. So do the caves and the fact that the Cyclopes "dwell apart on the crests of the mountains." Even the fertility of the soil, especially for grapes, goes well with volcanism. And in mythology the Cyclopes were the assistants of Hephaistos, the smith, who fashioned the thunderbolts. Pliny the Elder followed that tradition in calling volcanic bombs *cyclopum scopuli.* All in all, it is quite likely that Polyphemus is really Mt. Aetna.

But all poetry consists of weaving strands of ideas together, and

[1] Ibid., IX, 480-82.

it is probable that Homer had another thing in mind too, that he referred to living giants (or what were taken to be living giants) along with the personification of the volcano. Even that thought has a long tradition, and around the middle of the fourteenth century Giovanni Boccaccio announced triumphantly that the remains of Polyphemus had been found in a cave near Trapani on Sicily. He did not forget to mention that this find vindicated Empedocles who, in 440 B.C., had claimed that Sicily had once been the dwelling place of ferocious giants. The bones found in the cave seemed to indicate, Boccaccio wrote, that those giants were close to three hundred feet tall; it must have been distinctly unpleasant to meet them.

Those bones were preserved for centuries, and about three hundred years after Boccaccio's time they were still seen by the learned Jesuit Athanasius Kircher. Kircher described them as ponderous but added that Giovanni Boccaccio had exaggerated their size, the giants were not three hundred but only about thirty feet tall, still large enough to make them eat two normal humans for one meal.

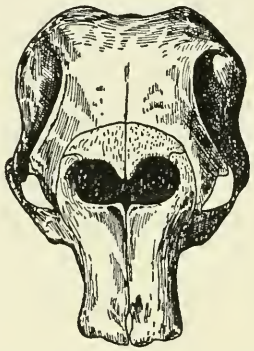
Unfortunately these bones were not preserved and Kircher, instead of picturing them, just printed a fancy "restoration" of Polyphemus. We can be almost certain what they really were: bones and skulls of elephants are often found in Sicilian caves, and we have seen what happened when elephant bones were found in Europe or in America.

But we are not finished with the Cyclopes.

For a long time the chief mystery that remained was why the Greeks believed their giants to be one-eyed, and that one eye placed in the middle of the forehead. It was Dr. Othenio Abel of the University of Vienna who not only explained that mystery, but even explained it in such a manner that it is now certain that these bones *must* have been the bones of elephants of some kind.

Practically everybody nowadays would recognize an elephant's skull, even if the long tusks were missing. But if you imagine that you never saw an elephant or a picture of one (and the elephant was unknown to the Greeks of the Homeric Age) you'll notice that the skull of an elephant bears some resemblance to a human skull of exaggerated size, especially if the long tusks are missing.

This similarity becomes still greater if you look at it from the front. But in that position, in spite of increased resemblance, you'll also notice an important difference. There are two large holes, which appear to be eye sockets. But they are not separated, they have merged, showing only in outline that there were once two. And that single "socket" is in a position which can only be described in everyday language by saying that it is "in the middle of the forehead." Actually the



Front view of an elephant skull, showing the "single eye," actually the nasal opening

"socket" is merely the nasal opening, while the real eye sockets are hidden if the skull is viewed from the front.

Even sailors of three hundred years ago, not to mention those of thirty-five centuries ago, would not have noticed such anatomical niceties. The big skulls to them were simply the skulls of big humans, distinguished from others not only by their size but also by the fact that they had "only one single eye in the middle of the forehead." And one can hardly expect these sailors to go home and report in a dry-as-dust manner that there was such a skull in such and such a cave. They would not tell of dried and dead skulls of giants, they would tell of giants that were very much alive and battled with them. And if they had not been victorious in those battles they would not sit in front of the harbor tavern to tell the tale. These tales must have been numerous . . . "polyphemus"!

While the special case of Polyphemus has been explained by Professor Abel, and while most of the other giants of pseudo-history have been actually identified by their preserved remains, one may ask now whether the actual giants of some three hundred thousand years ago may have any connection with the legend itself. A German professor by the name of Edgar Dacqué claimed, long before the first massive jaw came to light in Java, that the elephant skulls of Sicily and the mammoth bones elsewhere could have been interpreted as giants only if the legend of giants had had an independent existence prior to those finds. In short, he said, if there had not been something which people dimly remembered as giants they would not have thought of mammoth bones as remains of giants.

That reasoning is in itself untenable—one might as well say that American architects would not have built the skyscrapers of Manhattan if they had not had a dim memory of skyscrapers built by a forgotten race of the past.

But since we now know that there were real giants once, we may wonder whether they might not be responsible for the legend of giants. That may—that just conceivably may—be true. An encounter by a tribe of normal-sized men like those of *Sinanthropus* with another tribe twice as big and strong as gorillas must have made a deep impression. And, if remembered, it may have created a legend, which persisted even long after the cause for the legend had disappeared.

It therefore boils down to the question of how long people remember things. It is significant in this connection that there is no legend about the woolly elephant, the mammoth of the Ice Age whose bones posed so often as giants' bones later on. Yet we know that primitive Man hunted and ate those mammoths, that he drew pictures of them on cave walls, in short that he was very well acquainted with the animal, about as well acquainted as an African native with the hippopotamus. Yet the hippopotamus would be remembered by the African natives for quite some time, even if it became extinct today, since it figures in a large number of native songs. We may conclude from that example that the humans of thirty thousand years ago who still hunted mammoths and who could draw them well had still not yet

progressed enough in speech to remember those big hairy beasts for long after they had disappeared.

All of which means that the real giants, let's call them the zoological giants as distinct from the mythological variety, must have been still alive at a time when speech was well developed and when there already was an oral poetry. If the zoological giants did cause the legend, they must have existed, at least in small and scattered gangs, until, say, eight thousand years ago.

Offhand this possibility—as a possibility—cannot be denied. That the Chinese, in whose territory some of the zoological giants once lived, fail to have a corresponding myth may seem to bode ill for the hypothesis. But one may argue that the *living* giants did not necessarily have to last longest in the area from which their remains accidentally became known first. They may have vanished in China long before even oral tradition, but may have lived long enough elsewhere to cause tales which were then condensed into that single Biblical sentence.

One cannot very well deny the possibility. But one should not jump to such a conclusion until much more about the zoological giants is known. Once again, many more fossils are needed, just as in the case of *Pithecanthropus* early in its story. We need complete skulls —complete skeletons, preferably. And we have to establish their whole original range. With enough material we might succeed in establishing their wanderings.

We'll just have to wait. As the problem stands now, as of 1948, it is still possible that there were actual giants living in the Far East three hundred thousand years ago and that the sailors of the Mediterranean invented them independently three thousand years ago.

3: "... And Dragons Living in Caves"

THE DRAGON is the most gigantic and also the most fearsome of all mythical monsters. At the same time it is also the most indistinct. The reason is simple: the dragon is, so to speak, a synthetic creature. If the unicorn was based on poorly worded and misunderstood stories about the rhinoceros which was unknown in Europe at that time and was helped along on its path by that mistaken translation in the Bible; and if the giants were based on the finds of the skulls of elephants, also at a time when the elephant was not known to those who found the skulls, the dragon originated by having the name of one animal, and some of its characteristics, superimposed on not only one but several different ideas. One might say that there were not just dragons, but many kinds of them, and . . . but we'll see.

Some of the late dragons of history originated in precisely the same manner as Polyphemus, the giant of the *Odyssey*. Gigantic bones were found somewhere, of course they were the bones of giants. But sometimes that did not work. An elephant's skull, especially when the tusks were missing as they usually are, could still be thought to be a giant's skull. But what happened if, for example, the skull was that of a large rhinoceros, several varieties of which were once common in Europe? What happened then?

The answer can be found on a rather impressive monument in the market place of the city of Klagenfurt in Austria. The monument,

fashioned about the year 1500, shows a naked giant in the act of slaying a dragon with a large spiked club. The dragon has a body resembling that of a crocodile, with bat wings attached, and is furiously spitting at the giant—fire in the legend, water on the monument. But the skull of the monument is not that of a crocodile; aside from the more than incongruous leaf ears, it displays very clearly the outlines of the skull of the woolly rhinoceros, one of the contemporaries of primitive Man and of the woolly mammoth.

Chroniclers state that the dragon's skull was found near Klagenfurt about three decades before the monument was erected. But while the sculptor used it for a model, the skull itself was then brought to the town hall, where it could still be found after the First World War. Modern scientists have examined it repeatedly and have found it actually to be the skull of *Rhinoceros antiquitatis,* the woolly rhinoceros of the Ice Age in Europe.

Such fossils, therefore, as could not be classified as giant's bones, were made into dragon bones, just as the Chinese call any fossil a dragon bone, unless it is a dragon tooth. The monument itself is further proof for this theory, because a giant was invented to go along with the dragon. This connection between the two is a typical North European development of the time, say, after 1000 A.D.

That both were invented on the slightest pretext is evidenced by another piece of Austrian folklore—reported by Professor Othenio Abel—which is usually called the legend of the Foundation of the Monastery of Wilten. The underlying facts are insignificant almost to the point of being ridiculous. Near Wilten there is found a natural bitumen which has certain healing properties and has therefore acquired a considerable, though local, reputation. The local name is *Thürschen-Bluet,* an idiomatic term which may be translated as "giant's blood." Originally it was probably "dragon's blood," always a powerful healing agent in legend. Now, since there was blood, there must have been a battle, a battle in which the dragon was killed, as was the fate of every dragon that ever appeared in legend. To kill a dragon required a powerful adversary, and a giant was the safest assumption, since no particular hero was available for this vicinity. The giant received the name of Heymo, and it was said that when

he killed the dragon it had been guarding an orchard with a fence of pure silver and with trees bearing apples of pure gold.

It is evident that the man who first fashioned this legend did not have much original imagination, but did have some knowledge of classical mythology, for Heymo's exploit is merely a repetition of one of the deeds of Hercules. Only Heymo, a magnanimous fellow, though a giant, seems to have realized that he owed his victory to God and that an expression of thankfulness was in order. Hence, legend says, he took part of the dragon's wealth to found the Monastery of Wilten.

This legend did not exist in its full form in 1250, the year during which a chronicler mentioned that the bones of the giant (not those of the dragon) were kept in the monastery. The bones later disappeared, but the prior of the monastery had a statue of Heymo made, and two hundred years later the monastery suddenly produced another proof of the great battle. Visitors were told that Heymo after his victory had cut out the dragon's tongue, for which the monks fashioned a silver sheath, presumably with some of the silver from the fence of the dragon's orchard. The sheath was melted down in 1734, but the "tongue" is still to be found in the Museum of Innsbruck. It is the rostrum (sword) of a normal swordfish, probably from the Mediterranean and probably brought home by some pilgrim or crusader.

Professor Abel has called attention to the fact that most, if not all, later European dragon legends are associated with caves. The reason is simple: the remains of the "dragons" were usually found in caves, often covered with bat guano and therefore in surroundings of a somewhat weird character. Actually the skulls are those of the great cave bear, a gigantic extinct relative of the living bear that lived at the same time as the woolly mammoth and woolly rhinoceros. It was considerably larger than even the grizzly bear but apparently fairly harmless.

Critics have taken pains to point out that all these paleontological explanations refer only to late adaptations of an already existing myth. While they admit that the explanations fit the adaptations perfectly,

they insist that originally the myth of the dragon must have started with some living animal. Of course it did. And one can see the animal that started the myth in the reptile house of any well-stocked zoological park.

But first let us return for a moment to our old friend Konrad Gesner, who can always be relied upon to tell a complete story. Gesner, who carefully neglected to mention giants in his books, did write a long chapter on the dragon, or, rather, he prepared manuscripts for such a chapter as part of the fifth volume of his *Historia Animalium.* Although he died before he had a chance to do much more than make a preliminary survey, one Jacobus Carronus edited the half-finished parts he found among Gesner's papers and published them as "Doctor Konrad Gesner's Snake-Book, which is: a diligent and thorough description of all snakes and serpents living in the sea, in the fresh waters and on the earth, first collected and described by the highly learned and widely famed Herr Doktor Konradus Gesnerus and thereafter brought in this order and aggrandized by the very learned Herr Jacobus Carronus and printed in Zürich by Herr Jacob Froschower . . . ."

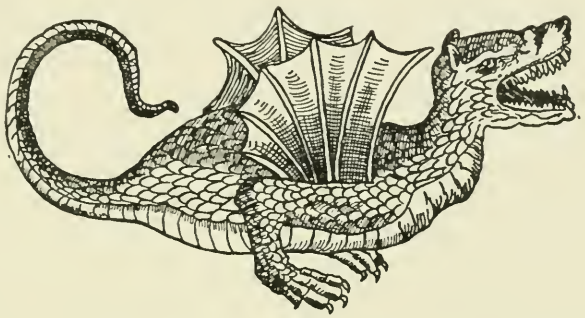
This essay begins with a few philological remarks about the Latin term *draco,* which, Gesner explains, is in reality the Greek word for "seeing with keen eyes" but was used by the Greeks for "snakes, especially for those snakes that are large and heavy and surpass all others in size." The same is true, said Gesner, for the German word for dragon, namely *Lindwurm,* for *lint* is merely the ancient Germanic word for snake. As a matter of fact, when they spoke of *dracones,* the classic authors meant giant snakes of the python kind. Pliny stated that they lived in India and fell down from trees upon their victims, whom they killed by encircling them in their coils. Gesner added (correctly) that "the dragons have little or no venom." The poets, continued Gesner, often imagined dragons to guard treasures, "probably to symbolize the danger of having possessions of great value . . . ." Gesner himself was poor all his life.

Then abruptly—so abruptly that it is apparent that the hand of the master had not time to knit the excerpts from other authors together—dragons with feet are mentioned. It is said that they possess

wings too. Gesner quoted Cardanus, the great physician and mathematician of Pavia, as authority for five "dried" dragons the latter had seen in Paris. There is no doubt that Cardanus saw some dried specimens of some kind in Paris. In his book, printed in 1557, he writes:

> Their wings were so small that, in my opinion, they could hardly fly with them. Their heads were small and shaped like the heads of snakes, they were of pleasant color and without feathers or hair and the largest of them was as large as a wren.

These dried specimens were certainly not works of art; "if so, they would have received larger wings to be under less suspicion."



"Young dragon" of Pierre Belon—in all probability a dried and mutilated specimen of the Javanese tree lizard *Draco volans;* middle sixteenth century

A French author of about the same time, Pierre Belon (Petrus Bellonius), printed a picture which in all probability shows the specimens mentioned by Cardanus. It is unmistakably a picture of the famous "flying dragon" of Java, a harmless little tree-lizard about four inches long. The "flying dragon"—Linnaeus gave it the name of *Draco volans,* in memory of the fanciful tales once told—does not fly, it is one of those "parachute animals" like the flying squirrel. On each side of its body half a dozen "false ribs" protrude and support a semi-circular or triangular, according to variety, skin which enables the small light lizard to extend its jumps from branch to branch into long glides.

Belon's picture shows only one pair of feet; the lizards had probably been mutilated. Complete specimens of *Draco volans* must have reached Europe later, since in one of the books of the learned Jesuit Athanasius Kircher (printed in 1678) a *Draco volans* from Java is pictured with only slight "improvements." The artist evidently used such a lizard for a model, thinking that it was a newly hatched specimen of the dragon of legend. Kircher claimed that the picture portrayed the once famous "Dragon of Rhodos," said to have been killed in 1345 by the noble knight, Deodatus of Gozon. Chronicles relate that the skeleton of this dragon was found, quite dead and dry, in a cave near the locality of the alleged battle. Deodatus, it should be said, hailed from Gascony in France, and Frenchmen have always had their own hardly flattering ideas about the veracity of their compatriots from that region. What the dead and dry skeleton was we don't know.

Incidentally, Athanasius Kircher had a beautiful theory about dragons. In his opinion the earth was honeycombed with caves. All kinds of monsters lived in these caves, most of them dragons. They were rare and mysterious only because the surface of the earth was not their natural habitat; the few that were mentioned in accounts of dragon battles with famous heroes were simply poor stragglers that had blundered into the open surface-world and could not find their way back.

Far from being creatures of the subterranean world, the Chinese dragons which, by the devious route of Chinese pharmacies, produced the evidence for extinct Giant Man, come from above. They are "cloud dragons," and the Chinese say that all the dragon bones and dragon teeth are the remains of such dragons as could not wing their way back into the clouds for lack of rain.

This sounds, in its own fashion, very much like Kircher's statement; the dragon, since it was so indistinct, was taken everywhere as an "animal from another world" which had by some mischance blundered into ours and then could not escape again.

It is said that the outward appearance of the Chinese dragon is derived from the alligator of the Yangtze Kiang, which is a small and harmless alligator. Where this statement originated I can't tell;

as far as the Chinese dragon's shape goes, any lizard might have been its original model, or even a dachshund, if necessary. But be that as it may, it is quite evident that the Chinese dragon is not the terrible monster of Western mythology. At its worst it is harmless, as a rule it is even benevolent.

While there are not quite as many books on the dragon as there are on the unicorn, their number is impressive. There are probably more books about the dragon than about any real animal—not counting those libraries of purely utilitarian books on domesticated animals. There are books on the Chinese dragon (I know of five, but there are probably fifty) and books on the Babylonian dragon. Of course there are books on the European dragon. All of them contain "explanations" galore, based on straight mythology, astrological mythology, on folklore, on linguistic developments—and even some on zoology. There are cloud dragons and water dragons in the explanations, and authors permeated with dragon lore have proved to their own satisfaction—especially their own—that the dragon is merely a symbol of the ocean, the snake that girdles the world. Others see a symbol of the thundercloud in the dragon, rainstorms with thunder and lightning —dragons spit fire—and point to the fact that all the dragons of art have wings, something one should not expect from either a marine or a subterranean creature. It fits in with this explanation that the German word for "kite" also means "dragon" (in Russian a "kite" is a "serpent," large, male, and mysterious) and that the Chinese dragons are cloud dragons.

It cannot be doubted that in folklore the dragon is merely a semi-personification of naturally destructive agents, a kind of antithesis to the benign sun which is swallowed by a dragon during an eclipse. Swiss and Austrian peasants say to this day that "a dragon broke out" when one of the wild and destructive mountain streams of the Alps changes its path.

But behind all these mythological and folklore dragons there must be a zoological dragon of some kind. And it does seem likely that the zoological dragon is just the snake, the venomous snake. The fact that such a small and unimportant-looking creature could kill with one swift bite was altogether mysterious, and snake cults have sprung

up wherever venomous snakes are found. Idolization naturally increased the size of the idol, and thus the pythons got into the story even though they have no venom. A parallel thought which intensified the dread of serpents was the *Blitzschlange,* the "lightning snake." There was a gigantic and still far more mysterious "snake" in the sky, which was snakelike in shape and luminous, which struck in a swift flash and killed as quickly.

The *Blitzschlange* probably contributed largely to the concept of the winged serpent: since it struck from the clouds it had to have wings. But the wings remained indistinct until *Draco volans* from Java furnished a model.

And with the wings of *Draco volans,* the size of the python, and the swiftness and strength of lightning, the picture-book dragon was finally formed—quite recently, after Roman times, even after the Middle Ages. And because of some fossils it lived in caves, guarding a treasure or a fair maiden, until a hero came and slew it.

Or at least said that he did.

4: Basilisk and Jenny Haniver

THEY were not gentle when they pushed their way through the excited crowd of burghers and servants, the armed city guards of Vienna in the year of Our Lord 1202.

"Make way for the Master of Justice of Vienna; make way, burghers, for the law, make way for Herr Jakob von der Hülben."

The excited chatter died down for only an instant. "Garhibl deserves the punishment of the Lord." "It should have been he who saw the basilisk." "Send him to court, bound and in fetters."

"Make way for Herr Jakob von der Hülben."

The crowd gave slightly.

"One should call a priest and a *Magister in artibus.*" "There is the the Magister, over there." "Silence, the Master of Justice comes."

Herr Jakob von der Hülben rode pompously through the gap his guards had made with shouting and pushing. He recognized the place that was the center of the near-riot, the house Schönlaterngasse No. 7. He also knew to whom it belonged, one Martin Garhibl, master baker in Vienna. And Justice von der Hülben was not much surprised: Master Garhibl was by no means well-reputed. Not that he had ever done anything contrary to the law—at least not to the knowledge of Justice von der Hülben—or cut down excessively on the weight or size of his loaves. But he was unpleasant and conceited; he behaved as if he belonged to nobility, and he was a miser to boot.

Master Garhibl was excited, very angry—and very much afraid when he suddenly saw himself facing Justice von der Hülben in person.

Nor did the Justice seem to be any too friendly.

"Pray tell me, Master Garhibl, what caused all this rioting. And be careful to tell the truth, it will be advisable."

"I did not cause this, Your Honor, it was the basilisk. The basilisk in my new well. But I had no part in it."

"He did," interrupted another voice. "He was swearing—that caused the basilisk."

"Silence!" Justice von der Hülben shouted. "Silence! You will all talk, but not all at once. Master Garhibl, proceed with care."

Gradually the Justice learned the story, in its main outline from Master Garhibl, in illuminating details from the others who gleefully added any point that might influence the Justice against the master baker.

Master Garhibl, it transpired, was constantly in trouble with his helpers and apprentices. None stayed with him, and it was always—yes, always, venerable Lord—Master Garhibl's fault. Only one young apprentice stayed on and not for Garhibl's sake but because of blonde Apollonia, the baker's daughter. At long last Hans, the apprentice, found the courage to ask Master Garhibl for Apollonia.

The baker lapsed into an incredible howling rage and ordered Hans to leave at once. It was in the early morning hours and it so happened that the cock was crowing when Hans opened the door. And Garhibl shouted after him: "If that cock, which is as impudent as you are, lays an egg—then you may come back and ask for Apollonia again."

Now today—all this happened months ago, venerable Lord—the cock was crowing at the usual time, just when the servant girl went to the well for fresh water. And in that well, the new one, she saw something shining and glittering, and a terrible smell came from the water so that she almost fainted. The master ordered the new apprentice to climb down into the well to see what was going on. The boy fainted, but was hoisted out of the well and revived. And he told that there was a monster at the bottom, not large, but terrible-looking and with fiery eyes. It looked as if it were composed of a rooster and a serpent. And it wore a small golden crown on its head.

Justice von der Hülben pondered the case. To disperse the crowd was easy and to take Master Garhibl into custody and make him pay a fine was not too difficult. But he had had no dealings with monsters

so far and his city guards did not look any too brave at the prospect of fighting one.

Fortunately the *Magister in artibus* the people had been talking about came to his rescue.

"*Exemplum est*—this is verily a basilisk," he began explaining. "Aristotle mentions him as the king of snakes—*basileus* in Greek meaning king—and wise books tell about the monster. Weapons do not help and its breath means death—but it can be combated. Its form and shape are terrible to look at, so terrible that the basilisk himself cannot stand the sight. A mirror, lord, a mirror is the weapon to be used. If the monster sees himself in a mirror he will die of fright. But beware lest the mirror-bearer die first."

"I will bear the mirror," said a voice. The Justice had only to listen to the crowd to know who had said it. "Hans of the yellow hair," they whispered.

"Take the mirror, Hans," said Herr von der Hülben with dignity, solemnity, and poise, "and if you kill the monster Master Garhibl shall give you Apollonia."

And many years after the wedding a brief inscription was carved on a slab of stone next to the door of Schönlaterngasse No. 7. It read:

Anno Domini MCCII
Kaiser Friedrich II was elected. During his rule a basilisk sprung from a cock. It was like the effigy shown above and the well in which it was found was filled with soil, doubtlessly because many people died from the venom of the monster.
Renovated in 1677 by the landlord
Hanns Spannring, bookseller

Unfortunately neither the house nor the inscription exists any longer; only the "effigy" of the basilisk has been preserved, and the legend.

The story of the Vienna basilisk is unique in claiming that such a monster was actually killed. Philologists have pointed out that the names used in the highly "romanticized" account are probably an addition made centuries later, but they do not doubt that the story itself actually does date back to the first decade of the thirteenth century. In fact it was that Viennese legend that kept the belief in the basilisk alive.

During the late Middle Ages an unknown author compiled a volume of animal legends which was printed for the first time in 1480 by Pieter van Leu in The Netherlands under the title *Dialogus creaturarum*. The eighth of these dialogues is one between the basilisk and a fish and begins as follows: "There is a kind of lizard that is called basilisk in Greek and regulus in Latin and Isidorus says that it is the king of all the snakes and serpents. Even serpents flee the basilisk because its breath is deadly and so is its appearance." The Isidorus mentioned is doubtless Isidore of Seville, but the unknown author of the *Dialogus creaturarum* did not have to rely on him for his information; there was nobody during those days who dared to doubt the existence of the basilisk, king of the serpents and of everything alive with the exception of man. The belief in the basilisk was old even then; it had remained unchanged since classical times.

But while the belief persisted, the supposed appearance of the monster had undergone considerable change. Pliny the Elder had described the basilisk simply as a snake, distinguished from others merely by its possession of a small golden crown. The author of the *Dialogus creaturarum* termed it a "kind of lizard," but already there existed a third version that was to become more and more popular. The basilisk, it was said, needed a number of rare events and coincidences to come into existence. It had to be born of an egg laid during the days of the dog star Sirius by a seven-year-old cock. Such an egg was easy to recognize; it did not have the normal ovoid shape but was spherical. Also it had no shell but only a tough skin or membrane. This egg had then to be hatched by a toad (it was a matter of dispute whether the cock might not also be able to hatch the basilisk). Naturally such an animal combined the features of its various foster parents: while essentially a serpent, it had the habits of a toad and some of the physical characteristics of a cock.

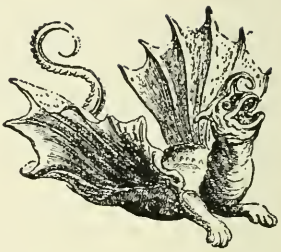
The Vienna legend was obviously based on the third and most complicated version of the story. And the "effigy" of the basilisk actually shows the general shape of a cock. It was, as already mentioned, preserved and was examined by a modern scientist, the famous Austrian geologist Eduard Suess. Professor Suess soon came to the conclusion that the effigy was actually the original basilisk and that there was a

definite reason for mentioning a well in the legend. The subsoil of Vienna consists mainly of clay with layers of sandstone, so that a well has to be dug through sandstone layers in order to reach the underground water. These layers, however, are not solid rock but consist of roundish pebbles that often cling together in strange shapes. The water, on the other hand, is not as pure and clean as the inhabitants might wish it; occasionally it is saturated with hydrogen-sulphur compounds that impart a bad taste and a very bad smell reminiscent of rotten eggs. From these geological facts Suess was able to reconstruct the story as it probably happened. A new well had been drilled which apparently showed a higher concentration of hydrogen-sulphur compounds than even the hardened Viennese were able to stand. After the gases had dissipated somewhat, people climbed down into the well to find out what had caused the "poisoning" and discovered a curiously shaped lump of sandstone that was then declared to be a dead basilisk.

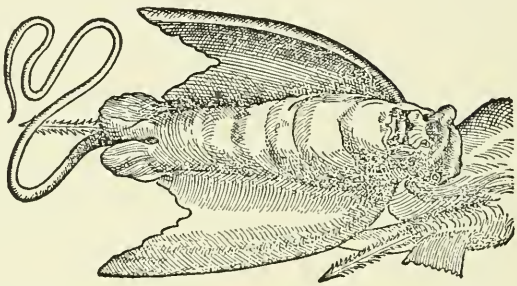
Even in scientific circles the legend of the basilisk survived until about the middle of the sixteenth century. Konrad Gesner of Zürich was the first well-known scientist who thundered against the belief in such a monster. "Women's gossip and false nonsense," he said, and later on stressed the fact that the occasional fainting spells and even deaths occurring in deep shafts and caves were caused by "bad, poisonous, moldy and stinking vitiated air." Though scientists agreed, the belief in the basilisk lingered on for at least two centuries longer with the general public.

At just about Gesner's time the story of the basilisk begins to mingle with that of the "Jenny Haniver." A Jenny Haniver—not to leave my readers in the dark about the meaning of the name—is an imitation monster, a fake fashioned from certain fish, usually skates or rays, and made to resemble whatever absurdity its manufacturer believed to be most unusual—and most salable. How the name originated for such fakes and what it really means nobody knows. Dr. E. W. Gudger of the American Museum of Natural History in New York, and Dr. Gilbert P. Whitley of the Australian Museum in Sydney, have tried their very best to trace the origin of this term but have failed. The only plausible suggestion so far made is that the second word may be a distorted form of Anvers, the French name for Antwerp, where

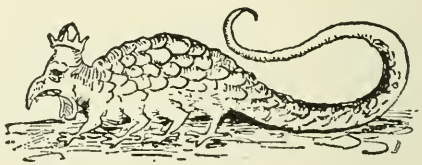
Above: The earliest known picture of a Jenny Haniver, from Gesner's *Historia Animalium,* vol. IV, Zürich, 1558



Right: "Basilic" from Duhamel du Monceau's *Traité générale des Pesches,* 1777



Above: From *De aquatilibus* by Pierre Belon, Paris, 1553. Gesner and du Monceau knew that their pictures were of artificial monsters; Belon did not say so



Right: The "Vienna basilisk," after Sebastian Münster's *Cosmographia,* 1598

Jenny Hanivers and basilisks from old natural history books

many Jenny Hanivers were probably made. Be that as it may, there is no doubt that these Jenny Hanivers greatly influenced the popular conception of the appearance of the basilisk.

Of course, there is no way of telling when and where dead skates and rays were transformed into Jenny Hanivers for the first time. It must have been fairly early, however, for Konrad Gesner, who dealt such heavy blows to the belief in basilisks, already knew of the existence of these fake monsters. In his book on fishes and other marine animals, printed for the first time in Latin in 1558 as the fourth volume of his great *Historia Animalium,* he even printed a woodcut of a Jenny Haniver, which is the oldest picture of one known. In the accompanying text Gesner tells that he saw such an imitation monster in Zürich in the traveling shop of a vendor of quack medicines who claimed that it was a basilisk, but there was no doubt that it had been fashioned from a ray. He specifically states that his reason for illustrating the deformed ray is to warn against such impostures purporting to be either basilisks or winged serpents or even young dragons. From the wording one receives the impression that making Jenny Hanivers must have been a very common practice. Although those brought to Switzerland and those preserved in various French, German, and Belgian collections were in all probability made in Belgium and France, there must have been another center of manufacture in Italy during the sixteenth century, because there are very many Jenny Hanivers in Milan, Venice, and Verona that are made from Mediterranean fish.

To change a ray into a Jenny Haniver is not very difficult. Anyone who has ever seen a ray swimming in an upright position near the glass of a large sea-water aquarium will recall the quite unpleasant sensation of having faced an evil living mask. Actually the staring "eyes" of the face are but the nostrils. The real eyes are on the dark back of the fish and are rather inconspicuous, especially on dead and dried specimens. It may be mentioned in passing that a dried ray looks rather harmless if viewed from above. To make it look weird the head has to be accentuated, which is accomplished easily enough by cutting into the large pectoral fins where they are connected to the head. If they are partly severed and pulled somewhat to the sides they give the impression of being wings. There are occasionally adult rays with non-adherent

pectoral fins, which are really permanent larval forms. It may well be that such nature-made Jenny Hanivers were the models for the artificial ones that must have sold so well a few centuries ago.

Once having started cutting the pectoral fins, the skillful artisan does not see any reason why he should be restricted to only two incisions. Two more cuts, one on each side, which partly sever a small strip of fin material, are an excellent way of producing forelegs, while the appendages of the pelvic fins of the male fishes need only slight manipulation to be turned into hind legs. Thus the harmless flat ray has already acquired two pairs of legs and a pair of wings. But it is the "face" that really affords an opportunity for the artist to show his skill. The flat mouth is pulled outward a bit to look more curved so as to resemble a human mouth more closely. Sometimes the tissue on either side of the mouth is pulled outwards to form cheeks or even more weird appendages that would serve no purpose at all if they actually existed. The tip of the head is then pulled so as to become more elongated; after this it is bent over to resemble a pointed hat or a bishop's miter.

This performed, there remained only a few more details for the artisan to finish: to insert artificial eyes into the nostrils, to dry the whole transformation carefully and in such a manner that the distortions would not disappear, and to find a customer. How the latter was accomplished is not quite clear, since not only Gesner, but practically every author writing on fishes after Gesner, described and pictured Jenny Hanivers with a full knowledge of the procedure for making them. But there must have been a good many people still willing to spend money for dead basilisks, possibly to convince their friends that the books were wrong and that the deadly monster did exist after all.

The strangest aspect of the whole matter is, however, that even nowadays Jenny Hanivers are occasionally fashioned. As late as 1929 and 1933 two "specimens" suddenly appeared in the United States. Both of them could be traced to their makers, simple fishermen in both cases, and it was found that they had never heard either of basilisks or of Jenny Hanivers. It had been simply the faint resemblance of the

fishes' appearance to a human face that had prompted them to try to increase the similarity by artificial means.

Many of the Jenny Hanivers that we discover in old books or in old collections possibly had a similar origin. But since at that time the ancient legend of the basilisk still lingered, they acquired a significance that would be impossible today. And the very fact of their existence not only increased the lifetime of the legend but noticeably influenced the conceptions of the form of this deadly monster that never lived.

5: The Vegetable Animals

THE STORY of the vegetable animals has no proper beginning. Like the strange mixtures of vegetable and animal life of which it pretended to tell, it was begotten by time and by the ocean and slowly grew with offshoots and misleading results.

Since there is no proper beginning to the legend I think it will be fitting to start with the epitaph of the man whose name combines—by way of a partly true, partly stolen, and partly fictitious book—the two branches of the story of the vegetable animals: the vegetable lamb of the East and the vegetable goose of the Northern West. That epitaph is found in Liège in Belgium, and reads:

Hic jacet vir nobilis Dominus Johannes de Montevilla, miles, alias dictus ad Barbam, Dominus de Campdi natus de Anglia medicinae professor devotissimus orator et bonorum largissimus paupribus erogator qui toto quasi orbe lustrato leodii dieam vitae suae clausit extremum anno Domini MCCCLXXII mensis novembris die XVII.

In translation:

Here lieth the noble Lord John de Maundeville, Knyght, also called à la Barbe, Lord of Campdi, born in England, professor of Medicine, illustrious orator, very rich, benefactor of the poor, who travelled over almost all the world and who passed from life in Liège in the Year of the Lord 1372, on the 17th Day of the month of November.

To the inhabitants of Liège the man who was to get this epitaph had been a prominent citizen and a well-reputed doctor who had settled there in 1343. His name was Jean de Bourgogne, but he was also called Jehan à la Barbe (John of the Beard). When he felt his

death approaching he called his neighbors and the city notables together and revealed to them that he was not only Jean de Bourgogne, the doctor they knew, but that he also was somebody else, the author of the book most of them had read: that he was Sir John de Maundeville.

After making these assertions he died—leaving to his contemporaries a book which appeared to them the most important travel book they had and which they consequently copied and recopied, translated and retranslated, until it had an incredible circulation. Aside from the book Jean de Bourgogne left an enormous riddle for the historians of posterity and they had to spend much effort and time to unravel at least the main parts of it.

The most important difficulty was that *Monsieur le docteur* de Bourgogne had changed his own story on his deathbed. Earlier in his life he had stated that he had traveled in the Near East, especially Egypt, and resided there for some time. There is no reason to doubt this statement in itself, but what followed is now thoroughly disbelieved. When living in Egypt, in Cairo to be precise, he had met the English nobleman Sir John Mandeville (or Maundeville, Mandevilla, Maundevyl, Mandevylle or any other spelling that comes to mind). Sir John had been born in England at St. Albans but had been forced to flee his native country on the 29th of September, 1322, because he had killed a man in a duel. Sir John was then embarking on a long voyage which in the end led him to the Far East and which had lasted thirty-four years, all told.

Later on Sir John had visited the doctor at Liège in order to be cured by him, as he was sorely suffering with gout. On that occasion Sir John had given him the manuscript of the famous book, which the doctor had circulated for the first time in 1355. (Strangely enough, it was written in French.)

That was the original story. On his deathbed the doctor suddenly admitted that he himself was Sir John de Mandeville, hence an English knight, hence the great traveler, hence the author of the book.

Historians never succeeded in finding an English knight of such or a similar name, save for one Sir Johan Mangevilain who, however, if he traveled at all, did so within the confines of the British isles. Jean de Bourgogne's deathbed admission was only partly true: he was no

English knight, but he had written the book, beginning with his actual experiences in Egypt and neighboring countries and then going on an imaginary voyage, stealing information right and left.

His sources could still be traced, five centuries later. One of them was the itinerary of a voyage written by a knight by the name of Wilhelm von Boldensele in 1336. Another one, used almost in full and virtually word for word, was the manuscript of the monk Oderich of Portenau, who had actually traveled to the Far East during the years from 1318-1330. Needless to say that Marco Polo belonged to the unknowing contributors to Bourgogne's "life-history," that the travel book by Carpini was used, that the classical authors Eratosthenes and Pliny the Elder became victims, and that Vincent de Beauvais' *Speculum* ("Mirror") was used.

It is part of Oderich's involuntary contribution which interests us here.

The Mandeville chapter *Of the Contries and Yles that ben bezonde the Lond of Cathay; and of the Frutes there* . . . contains the following marvelous story:

> [In Cathay] there growethe a manner of Fruyt, as thoughe it were Gowrdes: and whan thei ben rype, men kutten hem a to [cut them in two] and men fynden with inne a lytylle Best [little beast], in Flessche, in Bone and Blode as though it were a lytylle Lomb with outen wolle [lamb without wool]. And men eten both the Frut and the Best; and that is a great Marveylle. Of that fruit I have eten.

In exchange Mandeville (or rather Oderich) told his informants a story

> as gret a marveylle to hem [them] that is amonges us; and that was of the Bernakes. For I tolde hem hat in oure Countree weren Trees that beren a Fruyt, that becomen Briddes [birds] fleeynge: and thei that fallen on the Erthe dyen anon: and thei ben right gode to mannes mete [meat]. And here had thei als gret marvayle that sume of hem trowed it were an impossible thing to be.

Oderich did not invent that story in order to "outmarvel" his Asiatic informants, he merely told them something which was then generally believed in the West. Any man of education would have sworn that there was such a tree, growing in England, or maybe Scotland or Ire-

land, or at any event on some of the islands near England and Ireland, that bore a strange fruit which, if allowed to ripen on the tree, would become a bird and then grow into a small wild goose.

It had been set down centuries before Oderich made his trip to the Far East and Jean de Bourgogne claimed to have made it. The first reporter was one Giraldus Cambrensis, writing sometime between 1154 and 1189 A.D. But it is obvious that what he wrote in his *Topographia Hibernia* was already a well-developed version of the legend, and not its earliest beginning.

Speaking about birds "which are called Bernacae" and which are numerous in Ireland, he remarks:

> . . . against nature, nature produces them in a most extraordinary way. They are like marsh geese, but somewhat smaller. They are produced from fir timber tossed along by the sea, and are at first like gum. Afterwards they hang down by their beaks, as if from a sea-weed attached to the timber, surrounded by shells, in order to grow more freely. Having thus, in process of time, been clothed with a strong coat of feathers, they either fall into the water or fly freely away into the air. They derive their food and growth from the sap of the wood or the sea, by a secret and most wonderful process of alimentation. I have frequently, with my own eyes, seen more than a thousand of these small bodies of birds, hanging down from one piece of timber at the seashore, enclosed in shells and already formed.

After having assured the reader that "nowhere on earth" anybody ever saw these birds lay eggs or hatch them, the author mentioned that "some bishops and clergymen in some parts of Ireland do not scruple to dine off these birds at the time of fasting, because they are not flesh nor born of flesh."

It is this practice which has often led to the assertion that the whole story was invented by priests of the Catholic Church in order to have a well-set table even during fast. But things are not as simple as that.

Nobody has the slightest doubt that many individual monks and priests and even whole monasteries gladly seized upon the excuse that these geese were actually vegetables. There was learned argument enough to go even further and extend it to *all* waterfowl, reasserting Abelard's opinion that the sinfulness of an animal could be judged by its feet. That admitted ducks and geese to the table at the time of fasting because they did not have "feet" but "flippers." The learned also

quoted a certain line from a Latin poem by Claudius Marius Victor, the line which says *ergo materies avibusque et piscibus una est*—"therefore birds and fishes are of one flesh."

It was somewhat disturbing that the main witness, Giraldus Cambrensis, had condemned the practice himself, arguing that these birds, while not born of flesh, were still flesh themselves, just as Adam, while not born of flesh, was flesh. And the Roast Duck Party quickly lost the first and decisive battle when the highest Council of the Church accepted Giraldus's conclusion and expressly forbade the practice of eating the Bernacae during fast. The Pope himself, it was Innocentius III, pronounced the *prohibitus est.* That was in 1215.

The next severe blow fell some fifty years later, when another important churchman, Albert von Bollstädt or Albertus Magnus, rejected the story itself. *Omnino absurdum* was his verdict, and others repeated after him "fully absurd and an impudent lie." Albertus stated that he personally had observed the birds *in copula* and had watched them lay their eggs.

One should expect that the ban on eating the birds, followed by Albert's *absurdum,* finished the story. But it did not. The ban on eating the birds was observed, it is hoped, but there was no ban on quoting the "facts" of the case. And they were interesting "facts" and there were many reasons for telling them. One reason was very simply the ingrained *Wundersucht,* the craving for the miraculous, of that age. Another one was that many priests used it as an example of the Greatness of God. Even if it did not have gastronomical consequences, it was a proof for the abundance and variety of creation.

In fact it was a contemporary and pupil of Albertus Magnus, and hardly less famous himself, who contributed greatly to the continuation and improvement of the tree geese.

He was Thomas de Cantimpré, or Thomasius Cantipratensis. Following established usage and tradition Thomas first sought to prove that the vegetable goose was not a recent discovery, but that it could be found in classical writers—more, that the great Aristotle had mentioned it. "The barliates," Thomas wrote, "grow on trees as Aristotle says, they are the birds called barnescas by the common people."

There is one thing wrong with this nice quotation—no later scholar

succeeded in finding anything even remotely like that in Aristotle's writings. We now have the choice of believing that Thomas just invented the quotation in order to have Aristotle as his witness, or else that the copy of the Aristotle which he used was full of later insertions made by various copyists, not, of course, marked as such. The latter assumption is not only more kind to Thomas, it is also the more likely.

Thomas's book was fated to be translated from the Latin by the Archdeacon of Regensburg, Konrad von Megenberg and to be (in that form) one of the earliest books which was printed. There were several editions of this Book of Nature *(Puch der Natur)* and all of them carry a paragraph on the tree goose, called *bachad* in that case. The paragraph reads:

> This is a bird that grows from wood and that wood has many branches from which the birds sprout so that many of them hang from one tree. These birds are smaller than geese and have feet like ducks, but they are of black color. They hang from the tree by their beaks, also from the bark and the trunk. In time they fall into the sea and grow on the sea until they begin to fly.

This is not quite the same story as that of Giraldus. Giraldus said that they originate from driftwood which is being tossed around by the sea; Konrad (following Thomas and the spurious quote from Aristotle) states that they grow on trees like fruit.

This is the same version as related by Oderich, but it could not last long, because skeptics and credulous alike wanted to know where these trees were growing. At first the Flanders coast had been named; that was obviously untrue. One Gervasius Tilboriensis, who wrote around 1210, had said that it could be found in Kent in England. That was untrue too. Ireland was under suspicion, but from there came reports that the birds went north in Summer, which made one Sebastianus Munsterus, author of a much-read *Cosmographia,* place them on the Orkney Islands. To people living on the European continent the Orkneys were sufficiently far away to harbor such trees.

The book just mentioned had been published at Basle in 1598, and that the legend still existed at that time was due to an unusual combination of literary cross-currents and misunderstandings.

Only a few decades earlier Konrad Gesner had written his *Natural*

History. Being a well-read and careful and systematic man, Gesner knew that there were many marvelous and interesting stories around which could not necessarily be trusted. The tree goose was one of the stories about which he had doubt. Here was the report of Giraldus, often quoted by others without reservation. But here was Albertus Magnus, just published in a German translation by a certain Ryff. Who was right?

Gesner knew about a priest by the name of Octavius. Octavius was an Irishman, Octavius lived in Ireland. He should know—and Gesner had been assured by others that Octavius was a truth-loving man. Gesner wrote to Octavius and received a reply in due course. "By the religion I serve I swear that everything Giraldus said about the origin of this bird is true." Gesner had no choice but to accept this statement, and others accepted Gesner in addition to Giraldus and Octavius.

And Gesner's book, which appeared for the first time in 1555, only reinforced another book, the *History of Scotland* of Boethius of Aberdeen, published in Latin in 1527 and translated into English in 1540.[1] Boethius had no patience with those who believed in birds growing on trees like fruit:

Some men belevis that thir clakis [birds] grovis on treis be the nebbis [bills]. Bot thair opinioun is vane. And because the nature and procreation of this clakis is strange, we have maid na lytyll laboure and deligence to serche ye treuth and verite yairof [thereof], we have salit throw ye seis [sailed through the seas] quhare thir clakis ar bred, and I fynd be gret experience that the nature of the seis is mair relevant caus of thair procreatioun than ony uthir [any other] thyng.

Boethius was not only sure that it was mainly "the nature of the seis" which caused the whole thing, he also had received a rather complete impression of the stages of the development.

All treis that are cassin in the seis be proces of tyme apperis first wormeetin [worm-eaten] and in the small boris and hollis thairof growis small worms. The wormis first shaw [show] thair haid and feit and last of all thay

[1] *The Hystory and Croniclis of Scotland, with the cosmography and dyscription thairof, compilit be the noble Clerk Maister Hector Boece, Channon of Aberdeene.—Translatit laitly in our vulgar and commoun langage be Maister Johne Belleden, Archedene of Murray, and Imprentit in Edinburgh, be me, Thomas Davidson, prenter to the Kyngis nobyll grace.*

schaw their plumis and wyngis. Finally, quhan thay are cumyn [come = grown] to the just mesure and quantite of geis [geese] thay fle in the aire as othir fowlis dois, as was notably provyn, in yeir of God ane thousand iii hundred lxxx [1380] in sicht of mony pepyll, besyde the castell of Petslego.

As further proof for his theory Boethius related that once a tree was found at the seashore and was cut open by means of a saw with the consent of the "Lard" of the ground. It was found to be riddled with "a multitude of wormis," "mony" of them with "baith heid, feit, and wyngis." However, they had no "fedderis" (feathers).

Two more reports, both originating in England, have to be cleared out of the way first before it can be attempted to disentangle this multiply intertwined coil of beliefs, adopted prejudices, and real observations.

The first of the two, in spite of Boethius's hammering at the belief that there is a specific goose-bearing tree, defends just that point of view. The book in which it appeared, in 1597 in London, was called Herball, written (or better compiled) by one Gerard who is called a "Master in Chirurgerie":

> In the north parts of Scotland, and the Ilands adjacent called Orchades (Orkneys) are found certaine trees, whereon doe growe certaine shell fishes, of a white colour tending to russet; wherein are contained little living foules whom we call Barnakles, in the north of England Brant Geese, and in Lacashire Tree Geese; but the other that do fall upon the land, perish, and come to nothing: thus much by the writings of others and also from the mouths of people of those parts. . . . they spawne, as it were, in March or Aprill; the Geese are found in Maie or June, and come to fulnesse of feathers in the moneth after.

A Relation Concerning Barnacles even found its way into the Philosophical Transactions of the Royal Society of the year 1677/78. The *Relation* was, of course, much more carefully worded than any of the other books quoted, either because it was written for such an important scientific society, or else because the reporter, Sir Robert Moray, was "lately one of his Majesties Council for the Kingdom of Scotland."

"Being in the Island of East (Uist)," Sir Robert wrote, "I saw lying

upon the shore a cut of a large Firr tree of about 2½ foot diameter, and 9 or 10 foot long; which had lain so long out of the water that it was very dry: And most of the shells that had formerly cover'd it, were worn or rubb'd off. Only on the parts that lay next to the ground, there still hung multitudes of little Shells: having within them little Birds, perfectly shap'd, supposed to be Barnacles. . . . The Shells hang at the Tree by a neck longer than the Shell. It [the neck] is made of a kind of filmy substance, round and hollow, and creased, not unlike the Wind-pipe of a Chicken; spreading out broadest where it is fastened to the Tree, from which it seems to draw and to convey the matter which serves for the growth and vegetation of the Shell and of the little Bird within it. . . ."

The most important sentence of all this, good as the description of the observation is, is the last. It reads: "All being dead and dry, I did not look after the Internal parts of them, nor did I ever see any of the little Birds alive, nor met with anybody that did. Only some credible persons have assured me they have seen some as big as their fist."

It is clear from this last sentence that Sir Robert had his doubts whether the strange forms he saw actually *were* little birds—and the readiness to accept them as such is actually the error which held the whole story alive.

From the zoological point of view the "Barnacle Goose" is fully explained, and has been since about 1700. To begin with, there exists such a bird as was always described; it is the *Anser bernicla* of Linnaeus's system, the name being a deliberate allusion to the legend. Of course Albertus had been perfectly correct when he said that he had seen these birds breed and multiply in precisely the same manner as any other bird

What Giraldus and all the others after him had reported as the "young" birds—today we would say "larvae"—were no birds at all, but specimens of a strange-looking member of the crab family. The scientific name of the creature is *Lepas anàtifera* and, when fully grown, it looks very much like Sir Robert Moray's description. A tough leathery "stem" clings to a piece of driftwood, while the main part of the animal is enclosed in a shell resembling the customary bivalves.

A thicket of appendages protrudes from the shell, looking very much like the wet plumage of a bird.

Boethius had brought a third animal into it, the much-feared *Teredo* or shipworm. To express it in modern terms: he took *Teredo* to be an early stage of *Lepas* and *Lepas* to be the undeveloped bird. Three different creatures were thought to be connected by a marvelous and weird metamorphosis; small wonder that the result was fantastic.

Unfortunately this perfectly satisfactory zoological explanation is only one of the various explanations required. There are still some unanswered questions. One of them is why Giraldus, who has to be regarded as the first reporter simply because we don't know anything about his probable predecessors, accepted the idea of a bird growing out of a piece of wood at all. The other is why was this legend, once it existed, concentrated upon the wild goose which Linnaeus dubbed *Anser bernicla.*

The latter question has been answered quite some time ago by a professional linguist, Professor Max Müller, whose book *Lectures on the Science of Language* was published in London in 1864. Müller thought—and so far nobody had any better suggestion to offer—that it was merely the result of a linguistic confusion.

The birds in question, he said, became known first from Ireland and were therefore referred to as Irish Geese. Now the Latin name for Ireland is *Hibernia,* Irish Geese would logically be *Hibernicae* or *Hiberniculae*. The barnacles, the *Lepas* of zoology, were called *Bernaculae*. All that was necessary was to shorten the word *Hiberniculae* to *Berniculae* and birds and crabs differed by one letter only. Misunderstandings were easy, but would have been cleared up quickly and would have failed to do any harm if it had not been for the fact that just these *Bernaculae* had a shape in which the imagination could "recognize" an "unripe bird."

This leaves only one question, the question of whether the "recognition" of *Lepas* was, so to speak, the fulfillment of an existing legend or belief, with purely incidental fixation on the *Hiberniculae* for linguistic reasons.

That question has not received any satisfactory answer so far, but there is a possibility that there was such a legend, of the same order

of the other legend that certain tropical flowers, at a certain stage of their development, separate from the plant that bore them and fly away as butterflies.

One Dr. Carus, author of a German *History of Zoology,* thought that he might be able to point to Semitic sources. He said that the Jewish book Sohar contains a reference to a Rabbi Abba who told that he had seen a tree with fruits from which birds emerged. Such a short reference might, of course, be understood or misunderstood in many ways and does not sound too convincing. However, it is true that Jewish and Arabic literature do contain more conclusive statements of that sort.

The tales of Sindbad the Sailor provide one possible source. Among the marvels he saw in the Indian Ocean Sindbad mentions "a bird that cometh forth from a sea-shell and layeth its eggs and hatcheth them upon the surface of the water, and never cometh forth from the sea, upon the face of the earth."[1] That these tales were not translated in their entirety until the first decade of the eighteenth century has no bearing on the question. The Sindbad tales, when carefully analyzed, are found to contain so little original material that it can be assumed that each incident and item was known earlier and that it could be found somewhere and therefore might have made its way to Europe separately.

What "Sindbad" actually meant is not quite certain. The lines may refer to the strange breeding habits of the paper nautilus *(Argonauta argo),* an octopus which, like the real nautilus *(Nautilus pompilius)* produces a shell that resembles a large snail shell. But while nautilus and its shell are inseparable, Argonauta and its shell are not—or, I should have said, *her* shell, since in the case of Argonauta only the female produces a shell. That shell serves as a brood chamber for the eggs and is discarded when incubation is over and done with. That, of course, would be a "bird" which "comes forth from a sea-shell" but since it occurs in the Mediterranean Sea too, it is hard to see why it should be mentioned as a marvel of the Indies.

Pliny, who often was the source of the storyteller of the Sindbad tales, mostly second and third hand, mentions the nautilus "or, as some

[1] Lane translation.

say, pompilos" but really speaks about Argonauta, without saying anything about the habits of incubation just discussed.

Since there were such stories around in the Near East, Carus may have guessed correctly in thinking that the literary origin of the tree geese is to be sought somewhere along the shores of the Southeastern Mediterranean, but that it remained uncertain and groping until a zoological fixation on *Lepas* and a geographical fixation on Ireland and England took place. But we must not forget that such exchanges of natural history lore of the marvelous, as evidenced by Oderich, often go both ways, and that Ireland was in as nebulous a distance to the peoples of the Eastern Mediterranean as the East and India were to the North Europeans.

It is perfectly possible that this rather stable bit of natural lore did start with *Lepas* and in the North and that it made its way to the East, where for lack of *Lepas* it had to be projected onto something else.

The East was all the more receptive, since it also had a more or less indigenous share of semi-vegetables, of which the vegetable lamb of Brother Oderich was only the most outstanding example.[1] Later books on natural history had a simple and pat explanation for the vegetable lamb: they blamed it all on the existence of a certain fern that grows in many Asiatic countries and which represents an interesting oddity.

The fern develops a thick and heavy horizontal semi-root which runs a few inches below the surface. The real roots descend from this pseudo-root. Occasionally it happens that there are two pairs of verti-

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[1] Another one, hardly known to naturalists, is described in an interesting book which was privately printed in 1858. Its author was one Dr. L. Lewysohn, who called himself "Preacher of the Israelitic Congregation of Worms." The title of the book is *Zoologie des Talmuds* (Zoology of the Talmud). It consists of a systematic arrangement and identification of all the animals mentioned in the Talmud, with special indices of the Greek, Hebrew, Latin, and German names. The section on "Fabulous Animals" tells of the *Jidra,* "an animal whose bones are used to perform magic." It is described as being of human shape; whether it is also of human size is nowhere stated. The *Jidra* grows from the soil "like a pumpkin" and is attached to its roots by the umbilical cord. It eats the plants which are within reach and is mobile within the radius given by the length of its umbilical cord. Any animal or human which enters its circle is killed at once. In order to kill a *Jidra* the hunter has to take hold of the cord and pull it out of the ground or else break the cord by shooting at it with arrows.

This fable influenced one version of the story of the "vegetable lamb," as we'll see, and it also seems to have contributed a few features to the legends around the mandrake plant.

cal roots descending from the horizontal pseudo-root so that the whole, especially when dried, bears some resemblance to a four-legged animal with a tuft of greens in lieu of a head. As if to increase the similarity the whole root system, particularly the thick pseudo-root, is covered with fibers which suggest a pelt. And the sap of those roots is reddish, like thin blood. It may be remarked that it is not edible.

Western naturalists, when examining specimens of this fern, felt that here they had found the solution to the bothersome riddle of the "vegetable lamb" or *barometz* popularized by Oderich via "Mandeville." It was for this reason that Karl von Linné, or Carolus Linnaeus, the great Swedish systematician, called the fern *Polypodium barometz*.[1]

It seemed to be at least as good a vegetable lamb as *Lepas* was an unripe vegetable bird, and one version of the story itself is probably explained by it. That is the version in which the barometz grows out of the ground, being attached to its root system by its umbilical cord and capable of feeding only as far as that cord will reach—a perfect counterpart to the *Jidra* of the Talmud.

Traders who brought the fur called Persian lamb to the West claimed that it owed its wonderfully fine wool to the fact that it was not really the fur of an animal, but the fur of such a vegetable lamb. This story also accounts for the name of barometz, which is a corruption of the diminutive of the Slavonic word for sheep. It would be wrong to conclude that the fur traders invented the story "out of thin air" in order to protect their trade secret, namely, that these furs came from just-born or even unborn lambs. Most probably they just adapted an existing story of a vegetable lamb, and the Talmudic legend may have been the starting point.

The other version of the tale of the barometz is not quite as fantastic, it merely claims that there are certain trees growing somewhere in the East which bear fruit from which little sheep emerge. It was never made entirely clear whether those little sheep then grew up, separated from the tree, and ran away, or whether they remained part of the plant.

Because the strange fern root explains only the version which was mentioned first, some authors have felt that it is not a fully satisfactory

[1] The name was later changed to *Cibrotum glamescens*.

Vegetable lamb plant

(From a printed edition of Sir John Mandeville)

explanation and that there should be another and more comprehensive reason for the origin of this legend. Whereupon the British naturalist Henry Lee made a survey of all the offshoots of the tale which he could find and, after digesting the whole material and tracing its sources, announced an explanation of his own.[1]

It is a startling explanation and can be expressed in one sentence: *The barometz is really the cotton plant.*

"In tracing the development of the early and truthful accounts of the cotton plant," he wrote, referring to the reports rendered by Herodotus, Theophrastus, and Julius Pollux, "into the complete fable of the compound plant-animal we shall find it, as is the case with some other myths of the Middle Ages, attributable to two principal causes: 1. the misinterpretation of ambiguous or figurative language and 2. the similarity of appearance of two actually different and incongruous objects."

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[1] Henry Lee, *The Vegetable Lamb of Tartary* (London, 1887).

The latter refers to the similarity in appearance and texture of cotton and wool, the former to figures of speech like "the fleece that grows on trees," a perfectly good simile for cotton, provided it is not taken literally.

The error seems to have started with the choice of one particular word. Theophrastus, one of the very first authors to mention cotton, needed a word for the unripe cottonseed pod and chose *melon*. This word covered well what he had in mind because it has several meanings. One of the meanings of *melon* is "apple," or any other tree fruit, the other meaning is "sheep." It is easy to see why he should have chosen such a term, which expressed not only that the thing under discussion was a tree-fruit but also that it was, figuratively speaking, a sheep, a wool-bearer.

Unfortunately this choice made life difficult for translators, who did not have a word to cover both meanings. They had, in their respective languages, the choice of translating it either as "spring apple" or as "spring sheep," and since wool, or a vegetable substitute for wool, was under discussion it is not hard to guess which word they used. All that was necessary then was to take literally what was probably still figurative language . . . and the sheep that grows on a tree came into being.

6: *The Story of the Kraken*

THE WORDS which should go at the head of any piece dealing with that famous sea-monster, the kraken, were provided a little over two hundred years ago. In 1753, when Erik Pontoppidan, Bishop of Bergen, wrote the second volume of his big and beautiful *Natural History of Norway* he began the discussion of the kraken with the sentence: "Among all the foreign writers, both ancient and modern, which I have had opportunity to consult on this subject not one of them seems to know much of this creature, or at least to have a just idea of it. . . ."

It would surprise the good bishop if he could learn that even now, two centuries later, he is still largely right.

We still know very little about the "kraken," the gigantic relative or relatives of the small and medium-sized squids, calamaries, and cuttlefish. And the story of that truly awful monster of the sea is still mostly one that is founded on uncertainty, put together by way of hearsay, designed by the imagination and embroidered and polished by literary splendor.

Still and all, the story somehow holds together, mostly because there *are* some facts. They are scattered and many of them are insufficiently documented, but they are *facts*. And while a twenty-foot piece of foot-thick tentacle vomited in death struggle by a dying whale cannot very well replace the whole giant octopus that went with that piece of tentacle, it at least proves that there *is* a giant octopus of such size.

To myself, and to most anybody I have ever met, east and west of the Atlantic Ocean, the giant octopus is a literary acquaintance from

early childhood, encountered for the first time in the exciting pages of Jules Verne's *Twenty Thousand Leagues Under the Sea.* It is in the latter part of the novel that the submarine *Nautilus* is suddenly attacked by giant octopi. One man is carried off and the tentacles reach down into the boat for more prey. But by chopping off the tentacles with an axe the crew of the mysterious Captain Nemo save themselves and the boat.

Being of the impressionable age of ten at that time, and being eager to learn more about these unusual creatures, I went to the Supreme Authority of boys at that age: I asked my teacher. Little did I know then that grade-school teachers hardly know the things they are supposed to teach, and that they hardly ever feel the urge to acquire any information not required of *them* by their superiors.

I did not get the information I expected. Instead I was informed that I was too young to read Jules Verne to begin with, that it was not nice of me to read books by a Frenchman, and how was my collection of cherry and plum pits coming (this was in winter, 1916, and schoolchildren were ordered to collect all such pits they could find, for machine oil), and that the whole novel was, of course, only Gallic imagination. There were no such things as giant cuttlefish—and I often had the feeling later on that he would have denied the existence and possibility of submarines too, if the German press had not just embarked on a vigorous publicity campaign for the German submarine fleet.

Years later I came across the giant octopus again, this time in Victor Hugo. (I was still reading books written by Frenchmen.) By that time I already knew that one can look things up in libraries; the only trouble was that the library at my disposal was poor and small. It did not contain any of the few books in which the theme is discussed at any length—as I know now, because they are fairly scarce and all written in French or English. But the library did contain a few zoology books and a German counterpart of the *Encyclopaedia Britannica.*

The zoology books were silent on the subject of the kraken, as more than ninety per cent of *all* zoology books are, but the encyclopedia did contain a short paragraph stating that "there is evidence for the existence of very large octopi even though they do not attain the fabulous

proportions ascribed to them by old authors like Olaus Magnus and Erik Pontoppidan."

That was of little help to somebody who did not even know the names of Olaus Magnus and Erik Pontoppidan, much less their writings.

It took a lot of omnivorous reading to produce even a clear mental image of the sequence of the story of the kraken. It seemed that a Swedish archbishop, Olaus the Great, or Olaus Magnus, had been the first to mention the kraken, during the early part of the sixteenth century. He did so in a book on the history of the Northern nations. Later it turned out that this history, while highly imaginative, was not too reliable.

Olaus had also spoken about other sea monsters "off the coast of Norway" and had had an artist picture them. There were whales squirting fountains of water into frail ships, other whales with a whole mouthful of elephant's tusks, chewing up similar ships with evident enjoyment, big fish of some kind eating a fisherman's net full of fish and the fisherman along with it. The pictures were such that Konrad Gesner, when he wrote his gigantic folios on natural history around the middle of the sixteenth century, had reprinted Olaus's pictures, but without description and with a general heading stating: "Such monsters were put on plates by Olaus, how well and right is his responsibility to bear."

Just to make things more pleasant, Olaus himself was confused by many writers with his brother Johannes; they were both of the same approximate age, being only two years apart, and they were both archbishops.

A little more than a century later the kraken found its next historian in the Norwegian bishop Erik Pontoppidan. Again, half a century later, the scene of action shifted to France, where Denys de Montford devoted the greater part of his book on mollusks to the kraken (with hand-tinted illustrations). That was in 1802.

In spite of de Montford's fluent French rhetoric, and in spite of the brightly colored illustrations—or maybe because of them—all books became unanimous in asserting that "there ain't no such animal." From about 1810 to, say, 1860 nobody believed a word of all this and any mention was purely derogatory.

Kraken in action
(Adapted from Denys de Montford: drawing by Olga Ley)

Then, unfortunately, the "kraken" began to appear in person.

Huge carcasses, some of them still semi-alive, were washed up in several places like Scotland and Denmark, and a little later the waters around Newfoundland were found to be infested with them.

A Danish naturalist, Japetus Steenstrup, began to collect some of the evidence that had come to light and published it. Unfortunately Steenstrup, otherwise a man of merit, had just pulled one or two enormous boners that had to do with the question whether the woolly mammoth and Man had once been contemporaries. For a while Mr. Steenstrup's opinions were not apt to be very impressive.

But then the Newfoundland cases proved him right after all, and zoological science now admits the existence of gigantic octopi, even though the theme is still treated in a curiously diffident manner in most zoology books. The so-called "manuals" usually fail to list the gigantic varieties after listing the well-known types. Lydekker's enormous *Library of Natural History* (I have the edition of 1904) does not devote a single paragraph on any of its 3556 large-size pages to kraken. The even more enormous German *Tierleben,* originally written by one

Dr. Alfred Brehm and now a compendium of fourteen volumes, encyclopedia size, has just *one page* about it.

Of course there is a reason for this.

The strict zoological information on hand still consists mainly of the fact that giant octopi exist. Body weights of a ton or more, tentacles of a length greatly surpassing twenty feet, staring eyes ten inches in diameter, coloration ranging from dark green to bright brick red . . . these are the facts on record.

Places where such creatures have been found or observed are: the North Sea, especially its northern parts, both along the Scandinavian and the Scottish coasts, the Atlantic Ocean west of the Strait of Gibraltar, the Atlantic Ocean around Newfoundland, the Caribbean Sea, the Pacific Ocean around the Philippines, and Northeast Australia and the Antarctic Sea.

It is fairly well established that there are several varieties of them. There is little doubt about their food: anything alive provided that it is not vegetable in nature.

But the two things for which we really want to know the answers still remain question marks. One of them is: what are these giant varieties? Are they special varieties of which we know nothing except those chance specimen or pieces of chance specimen? Or are they simply incredibly old individuals of known varieties? There is some reason to believe that at least some varieties of octopi grow as long as they live. Most individuals, of course, find a violent end before they get very old. Some fish like octopus. Whales, especially the toothed varieties, seem to hunt especially for octopi, their hunting seems to be beyond mere liking, octopi appear to be their favorite subsistence. Then, of course, larger octopi eat smaller octopi, as has been observed often enough in aquariums.

Are the giants just individuals that managed to escape all mishap for centuries? Do we have their "young" in our museums without knowing it?

The other unanswered question is: where do the giants usually live? In the South Seas they are often encountered emerging from the cracks of coral reefs, in water shallow enough to be accessible to human pearl

and sponge divers. It seems likely that submarine caves, in water of two hundred fathoms or less, are their favorite haunts. The sudden abundance of giant octopi around Newfoundland has been explained, for example, by saying that something happened to their submarine caves in about 1870. Tectonic events may have forced them to the surface into the open sea for a number of years at that time. Or it may have been just a shifting of currents of the sea, which made the old haunts uncomfortable.

Or are these animals encountered near the shore all chance specimen? Are they essentially animals of the high seas, living an unsettled life at a depth of one hundred fathoms or thereabouts? The facts that they are unlikely to encounter a sufficient amount of large prey at greater depths and also that they are so successfully hunted by whales (mammals which have to come to the surface for air) speak against the oft-advanced hypothesis that they normally live at the bottom of the sea.

This is the outline of the story. Now for some detail. When I came to New York in 1935, and found an entirely new large library at my disposal, I decided to go in for some literary research, and the kraken was one of the subjects on the list. The New York Public Library, I have been told, has a little over two million volumes. The Prussian State Library in Berlin, to which I was used, had close to three million, before large sections were destroyed during World War Two, or confiscated by the Russians afterward.

The interesting point is that the two libraries overlapped to such a slight extent that it was surprising. Especially as regards older books you could almost count on finding in the one what was lacking in the other.

The first thing I looked for and found was Olaus Magnus, an English edition (the original is in Latin) printed in London in 1656 and entitled: *A Compendious History of the Goths, Svvedes & Vandals, and Other Northern Nations: written by Olaus Magnus, Arch-Bishop of Upsall, And Metropolitan of Svveden.*

It is in Chapter V of the Twenty-first Book that the kraken appears:

There are monstrous fish on the Coasts or Sea of Norway, of unusual Names, though they are reputed a kind of Whales, who shew their cruelty

at first sight and make men afraid to see them; and if men look long at them, they will fright and amaze them. Their Forms are horrible, their Heads square, all set with prickles, and they have sharp and long horns round about, like a Tree rooted up by the Roots: They are ten or twelve Cubits long, very black, and with huge eyes: the compass whereof is above eight or ten cubits: the Apple of the Eye is of one Cubit, and is red and fiery coloured, which in the dark night appears to Fisher-men afar off under Waters, as a burning fire, having heirs like Goose-Feathers, thick and long, like a Beard hanging down; the rest of the body, for the greatness of the head, which is square, is very small, not being above 14 or 15 Cubits long; one of these Sea-Monsters will drown easily many great ships provided with many strong Mariners. . . .

The description is not at all bad, with its emphasis on the large size of the head compared with the size of the body, the gigantic eyes, the tentacles looking like the roots of a tree—there can be no doubt that Olaus, even if he had never seen a giant octopus himself, had eyewitness accounts to go by. And, if his remarks mean anything at all, that he had accounts from eyewitnesses who had been badly frightened.

So this was history's first account of the giant cuttlefish.

I looked for the second, Pontoppidan's, and found that too, an English edition of his *Natural History of Norway,* published in London in 1755 in a very big, well-printed, perfectly bound, and neatly illustrated folio volume of some ten pounds. The Norwegian original had been written in 1751, the second volume in 1753.

Well, Bishop Pontoppidan did put it on somewhat thick. His kraken lies in water of eighty or one hundred fathoms offshore, but sometimes the fishermen find only twenty fathoms. When they do, they know that they will have an overabundant catch, but they also watch the depth, because it means that the kraken is rising to the surface. Sometimes it does not actually come up, but when it does, it looks at first like a number of small islands. Finally the whole back appears "about an English mile and a half in circumference—some say more but I chuse the least for greater certainty."

These are fishermen's stories, as admitted by the bishop. But there is one little paragraph, tacked on like an afterthought, which looks as if it were a report of an actual event:

In the year 1680 a *Krake* (perhaps a young and careless one) came into

the water that runs between the rocks and cliffs in the parish of Alstahong. . . . It happened that its extended long arms caught hold of some trees standing near the water, which might easily have been torn up by the roots; but besides this, as it was found afterwards, he entangled himself in some openings or clefts in the rock, and therein stuck so fast, and hung so uncomfortably, that he could not work himself out, but perished and putrefied on the spot.

Having finished with Pontoppidan, I sat on one of the stone benches in front of the Public Library and wondered. Something was not quite right with all this. It was not the obvious exaggerations of Pontoppidan's fishermen's tales. It was modern commentary. Why did they all say, probably copying from one another, that Olaus and Pontoppidan were the earliest two sources for the giant squid? I seemed to remember something much older.

Roman?

Gaius Plinius Secundus, commonly known as Pliny the Elder?

Yes, of course, Chapter Forty-eight of the Ninth Book, where the old cavalry colonel told the story of the "polypus" of Carteia, a place in Spain, just outside of the entrance to the Mediterranean. "It was only with the greatest difficulty that it could be dispatched with the aid of a considerable number of three-pronged fish-spears. The head of the animal was shown to Lucullus, it was as large in size as a cask holding fifteen amphorae of wine"—a considerable cask, since an amphora was about nine gallons.

The tentacles of that octopus, amusingly called "beard," were so thick that a man could not reach around them with both arms and were thirty feet long. Some remains were preserved for some time; they weighed seven hundred pounds.

I don't know why Olaus, who wrote in Latin himself and certainly had access to a copy of Pliny, failed to mention him in order both to prove his erudition and bolster his own case. I know even less why later writers kept harping that Olaus and Pontoppidan were the first to mention the giant octopi.

But even Pliny did not satisfy me. He was a much older source all right, but Pliny was not what I had vaguely in mind. There was still another one—after Pliny, or contemporary, or older than Pliny? It was

the thought of "still older" which proved fruitful. After all, there were not too many: there was Strabo, then Herodotus, and Hesiod, the probable contemporary of Homer . . . of course, Homer's *Odyssey,* the story of Odysseus's encounter with Scylla.

The description given in the epic itself is clear enough:

. . . but her form is a sight portentous that no one
E'er would gladly behold, not even a god if he met her.
Round her a dozen of feet she is always waving suspended
Six long sinuous necks outstretching before her and each one
Beareth a head terrific with teeth in a threefold order,
Many and thickly arrayed, where gapes death's cavernous blackness.
Up to the midmost parts she is hid in the depth of the cavern
Whilst from her lair in the fearful abyss six heads she extendeth
Hunting for fish at the foot of the rock and peering around it,
Dolphins to catch or dogfish, or haply another and greater
Beast. . . .[1]

It contains all the now familiar elements, the cavern in which the monster waits, the nervous play of the tentacles, some of which are invisible as a rule, the generally terrifying appearance which would dismay "even a god if he met her." The "teeth in threefold order" are probably the sucking disks of the tentacles and that their total number is wrong (twelve instead of the possible maximum of ten) proves nothing against the story itself.

Here we have an old, a very old account of an encounter with a giant squid, written at the latest in about 650 B.C. but probably a century or two earlier.

Homer, not Olaus, had introduced the giant octopus into literature.

Later it occurred to me that Scylla is not the only mythological monster which can be traced back to the frightening appearance of the kraken. There is another one: Medusa.

She too appears for the first time in the *Odyssey,* mentioned as a monster of the underworld—the *Mythological Lexicon* contains an explanatory note saying that the Gorgon's head lived in the realm of the dead, the Far West, which then meant the coast of the Atlantic Ocean and Spain.

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[1] *Odyssey,* XII, 87 and following.

Hesiod then knows three Gorgons: Stheno (the mighty), Euryale (the far-springer) and Medusa (the queen). They were the daughters of the sea-god Phorkys and of Keto. Medusa especially was very beautiful and finally attracted the attention of Poseidon. During their liaison they defiled one of the temples of Athena; and Pallas Athena, armed and armored as always, and eternally on tense terms with Poseidon, changed Medusa into a monster of extreme ugliness, with writhing snakes for hair. The king Polydectes (needled by Athena?) sent Perseus to slay Medusa. Whether Athena had caused Perseus's punitive expedition or not, she gladly aided him and gave him the advice which saved Perseus from the petrifying stare of Medusa. The two sisters tried to kill Perseus in turn, but their pursuit was ineffectual.

Before we go on, it must be mentioned that the classic picturizations of Medusa acquired the shape of a coldly beautiful woman with snakes for hair rather late. The early picturizations are different. They show the head only—it was used to fill round spaces, like shields, coins and later even doorknobs—but it is a face which has little resemblance to a human face. It is round, with large eyes and a cleft tongue protruding from the open mouth. Instead of snakes there are only scroll lines, which may be taken for hair, or for snakes, or merely for space-filling lines.

When one examines the story it becomes clear that it is a sea story. Medusa is the daughter of one sea-god and the beloved of another one. She dwells in the Far West, in or at least near the ocean. Perseus's trip is a sea voyage, he kills Medusa at the seashore. Her sisters, who are immortal—i.e., who were not killed by Perseus—pursue him ineffectually, since he is on land and under the protection of the (land) goddess Athena.

Medusa, in short, was a sea monster, of a type which looks as if it were only head, with staring, terrifying eyes, with writhing "snakes" surrounding her face.

I said earlier that nobody around the middle of the nineteenth century believed in the existence of large octopi or squids any more. The kraken had been finally "unmasked" as a product of the imagination of Nordic fishermen, of a time, be it noted, when heart- and

body-warming rum had already been introduced along the Scandinavian coastline with outstanding success.

This opinion was still firmly grounded in 1860.

In 1861, a few weeks before Christmas, the French corvette *Alecton* made port with a very unusual report. The *Alecton* had been about one hundred and twenty miles northeast of Tenerife on November 30th, in a calm sea and with a clear sky, the air being unusually warm, when the lookout man sang out that there was "a large body, partly submerged, drifting at the surface."

The commander of the corvette ordered approach and investigation, thinking that it might be a half-submerged wreck. It turned out to be a gigantic squid. The bright brick-red body was about eighteen feet long, the tentacles another eighteen feet or more. The eyes, which were coal-black and had a cold, glassy stare, measured ten to twelve inches across.

Since the *Alecton* was a war vessel there was no lack of armament. Solid cannon balls were shot at (and through) the animal, which, though lazily drifting, was unmistakably alive. Harpoons were thrown at it. Ship and kraken were immediately alongside (which made the estimate of the measurements so accurate, there was no way of missing). But apparently there was also no way of hurting the creature, the cannon balls penetrated without causing much of a reaction, the harpoons did not hold in the flabby flesh.

The monster did not even seem greatly disturbed by the furious attack. The giant squid disappeared under the surface three or four times, but always reappeared after intervals never exceeding five minutes. After several hours of intensive naval action one of the cannon balls hit a vital spot, the monster vomited large quantities of messy mucus and half-digested food, producing an intense and oppressive stench, even more oppressive because of the heat of the day.

At about that time one of the men succeeded in throwing a noosed rope around the squid. It slithered along the body but caught at the big fins at the rear end. The men, in an incredible display of bravery, tried to haul the still living monster aboard, but the flesh was so soft and the weight so great that the rope severed the tail end of the kraken. That part was salvaged; the main part disappeared under the

surface for good. But even the salvaged section quickly became so "high" that it had to be thrown overboard . . . the *Alecton* had no other proof than the word of her commander and the affidavits of her whole crew when she made port.

The case was put down as a case of mass hallucination!

Captain Bouyer's reply is, unfortunately, not on record.

The encounter of the *Alecton* (which prompted the famous kraken scene in Jules Verne's story of Captain Nemo and the *Nautilus*) had been preceded by all the cases which Denys de Montford had collected, among them one in which a kraken had actually reached up into the shrouds of a vessel and torn a sailor from his perch. One of the tentacles had been hacked off in the battle; it measured twenty-three feet.

Only a few years before the *Alecton* case (in 1854) a large specimen had stranded on the Danish coast. The fishermen cut it up for bait, but the nine-inch beak was saved. Some three or four years later a seven-foot calamary stranded in the Shetlands. It was badly mutilated but could still be measured, the eight "short" tentacles were eight feet long, the two long tentacles sixteen feet each.

These were the two cases which made Steenstrup undertake his investigation—but it did need the "Newfoundland series" to clinch the case.

In 1873 three fishermen off the Newfoundland coast saw a shapeless mass floating upon the water. Hoping for salvage they rowed up and struck it with their boat-hook. At once the shapeless mass opened up into what looked like an umbrella, two green eyes stared at the men and two tentacles gripped the boat. The monster ejected a large amount of black fluid when one of the fishermen severed both tentacles with his hatchet, and disappeared. One of the tentacles was cut up for bait before a Reverend Mr. Harvey (the reporter of this case) saw it. The other, lacking six feet used up for bait, still measured nineteen feet, while the fisherman swore that another ten feet had been left on the kraken.

Soon afterward another one caught itself in a fish-net, the body measuring eight feet in length and five feet around, the long arms twenty-four feet, the short arms six feet. The eyes were four inches

in diameter. Only a short time later one was taken alive at Coombe's Cove, Fortune Bay; the eight short arms measured six feet on the average, the two long arms forty-two feet, the body ten. A specimen cast ashore in 1877 was brought to the New York Aquarium; it was nine and a half feet long and seven around. The long arms measured thirty feet each, the eyes had a diameter of eight inches.

During the same year a specimen of similar size was washed up at Trinity Bay and was observed struggling desperately and fearfully to escape from the shallow portion into which it had been deposited by the tide. "In its struggles," an eye-witness reported, "it ploughed up a trench thirty feet long and of considerable depth, by means of the stream of water that it ejected with great force from its siphon."

For a few more years giant cuttlefish and calamaries of many types were a fairly frequent event along the Newfoundland coast. Then they became rare again.

Some more and less direct evidence has been furnished by whalers. Toothed whales, vomiting in death struggle, have shown evidence of still larger kraken; in one case a six-foot piece of tentacle, *with a diameter of two feet,* has been claimed. Another claim goes for marks on the skin of such a whale, looking like the mark of a sucking disk over two feet in diameter.

There is no longer any doubt that cephalopods of truly gigantic size do exist. But the knowledge that they do exist is only the fundamental item on the long list of things which we would like to know about them.

7: *The Great Unknown of the Seas*

THE STORY of the Great Unknown of the Seas begins somewhere in the cold waters off the northern Norwegian coast, where the midnight sun sheds a reddish light on eternal glaciers which in winter are illuminated by the bluish fire of the aurora borealis.

It was in these surroundings of sea and spray, cliffs and ice, that stories of the great sea serpent were first told. Hardy Norse fishermen and sailors knew that the monster stuck its small head and long neck out of the water of the fjords and the boulder-dotted coastal waters between the mainland and the open sea. And, they said, the appearance of the sea serpent was an evil omen. When the fiery eyes of the sea serpent shone through the mist and spray, tragic news was sure to follow.

The "chronicler of sea monsters and midnight marvels," Archbishop Olaus, became the first chronicler of the sea serpent too. But Olaus, as has just been told, was a credulous and careless man, and as soon as that fact had been thoroughly realized by more skeptical people elsewhere, everything Olaus had ever mentioned began to be discredited on principle. Olaus had told about the kraken, of course there was no such thing. Olaus had told about the sea serpent, naturally . . . oh well, Olaus Magnus of Upsala . . .

That Erik Pontoppidan got mixed up in the story of the sea serpent too was another negative asset—Bishop Pontoppidan, wasn't he the one with the kraken a few miles in extent?

But then there came those real kraken, still very much alive and as tangible as a shark or seal. And with the real kraken there came —no, unfortunately no live sea serpents, but more and still more stories *about* live sea serpents. And some people began to wonder whether it is so absolutely correct that "skepticism cannot be overdone." Maybe there was, after all, something in those sea serpent yarns. But many who started thinking along that line learned to their sorrow that most people begin to smile the moment the words "great sea serpent" are even mentioned.

There exists a well-authenticated story about a sea captain of a passenger liner who was just having lunch when the officer of the watch sent a seaman to his cabin, asking him to come to the bridge "if you have the time, sir," because a sea serpent had been sighted. The captain flatly refused to go to the bridge or even on deck and kept his eyes on his food and away from the portholes of his cabin until another dispatch informed him that the sea serpent had passed. Later he explained: "Had I said that I had seen the sea serpent, I would have been considered a warranted liar all my life after."

It is a matter for great admiration, therefore, that there have been many sea captains who did not avoid looking at sea serpents, but who did their best to get an accurate impression of size, shape, and probable nature of the animal and who did not hesitate to report what they had seen and to enter their observations in their logbooks. It has to be kept in mind that these captains gained nothing by doing so but ridicule and reproach, in fact that they sometimes risked their positions for so simple and basic an emotion as the love for truth.

During the last five decades the number of men of solid reputation and standing (including some speaking for commercial and scientific institutions) who are willing to be at least open-minded about the sea serpent has steadily grown. And it is very important to fix in one's mind that these men use the term "sea serpent" with great reluctance and merely as a label, since this happens to be the established name. None of them is willing to believe in a real "serpent," that is, in a large marine snake (beyond those sea snakes of the Indian Ocean which are in zoology books and aquaria). They all use "sea serpent" to mean something in the seas which is in all probability a large ani-

mal, undiscovered and unknown, and probably even of mammalian nature.

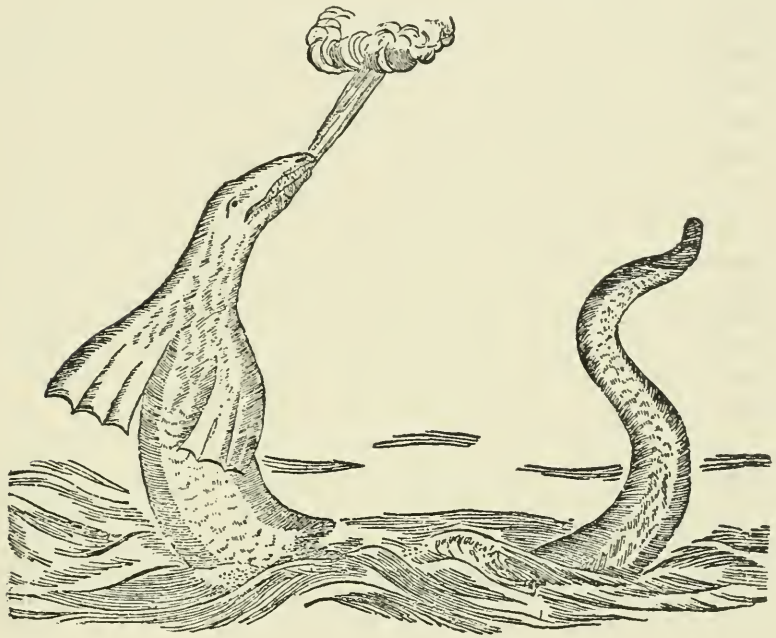
The first professional zoologist who had the courage to come out openly and say "Yes, I believe that there is a large undiscovered animal in the seas and here are my reasons for this belief," was Professor A. C. Oudemans, director of a zoological park in Holland and Member of the Royal Dutch Zoological Society. In 1892 he published a large-sized book of 592 closely printed pages which is now hard to obtain—I succeeded in getting a copy from England early in the war —which he called *The Great Sea Serpent.*

Dr. Oudemans's book contained two hundred reports of encounters with, or observations of, this unknown animal. It is doubtless true that some of these reports are erroneous interpretations of fact, and some are even deliberate hoaxes, but it is equally true that at least half of them are sincere and trustworthy reports of observations made by men who grew up on or near the sea and who could, even in bad weather, tell the difference between a shark, a seal, a whale, and something else.

One of the favorite "explanations" of many people who do not take the time to acquaint themselves with the material amassed by Professor Oudemans, as well as that more recently compiled by Lieutenant-Commander Rupert T. Gould of the British Royal Navy, is that the sea serpent is only an optical illusion caused by a school of dolphins or porpoises. These "interpreters" say that ten dolphins leaping one behind another may well give the impression of being ten coils of one large black serpent winding its way through the waves. This school-of-porpoises-swimming-in-a-line theory has a striking air of plausibility, except for two weaknesses. It assumes, first, that old salts do not recognize porpoises when they see them; and, secondly, it assumes that the reports of these observers speak of a gigantic snake. But they do not.

Much of the resistance to the seemingly obvious consideration that after all some observers may actually have seen an unknown animal is the result of a mistaken application of an otherwise sound rule: that for any controversial story one should always go back to the original source. In this case, the original source is—or so it is believed—the account by Olaus Magnus, usually quoted in the version given by Konrad Gesner. Now Gesner's "Great Wall Snake" and Olaus's "Sea Orm"

were actually described as enormous snakes, three hundred feet long, "rolling their coils in gigantic spirals," attacking small ships, and snapping sailors out of the vessels that passed close to their caves. It may be hard to prove, but I have the feeling that it was the Scylla of the *Odyssey* that caused Olaus Magnus to introduce these man-eating habits into the classic sea serpent lore, for the hodgepodge nature of which he is largely responsible.



Hans Egede's sea serpent

(From his book *A Full and Particular Relation of a Voyage to Greenland in the Year 1734*)

Yet the sea serpent is not merely a literary tradition requiring that one go "back to the original" for its explanation. The persistent stories of sea serpents are mostly based on obviously sincere eyewitness reports and not on the continuity of a tradition. Therefore each of these reports should be treated as an "original." And the point upon which they all

agree is the existence of an animal that is *not* a gigantic snake, nor a sea orm. Even the very earliest report of a man who claimed to have seen the "monster" with his own eyes does not repeat any of the details that have brought so much justified ridicule on Olaus Magnus's sea orm.

That earliest eyewitness on record was also a priest, Hans Egede, "the Apostle of Greenland," who sailed from his native Norway in 1740. His ship was still off the west coast of Greenland when it met with the most remarkable adventure of the whole trip. Egede carefully recorded it in his journal (without undue emphasis, it might be remarked), and possibly supervised the drawing of a picture of the animal encountered, which was later used by his son Povel as the frontispiece of the printed edition of the journal. The entry reads:

> Anno 1734, July. On the 6th appeared a very terrible sea monster, which raised itself so high above the water, that its head reached above our main top. It had a long sharp snout, and blew like a whale, had broad large flappers, and the body was, as it were, covered with a hard skin; and it was very wrinkled and uneven on its skin; moreover on the lower part it was formed like a snake, and when it went under water again, it cast itself backwards and in so doing it raised its tail above the water, a whole ship-length from its body. That evening we had very bad weather.

Critics have said that the last sentence of this entry proves that Egede's sea serpent was the offspring of Olaus's midnight monster, but the whole tenor of the entry belies this interpretation. What Egede meant to say with this sentence is most probably that at the time of the encounter the weather was not bad. This seems to be important because of all the later well-authenticated sea serpent reports only a very few (roughly two per cent) mention bad weather. This may indicate that the sea serpent does not come to the surface unless the water is smooth and the weather good. As a matter of fact, it would be more in keeping with the tradition of superstition if the sea serpent did come to the surface in bad weather—presumably to prophesy doom—while the good-weather habits point strongly in the direction of a real animal.

Hans Egede's story is perfectly simple and clear. An animal with a large body and long neck (reaching to a height of about thirty feet [1]),

[1] Unfortunately the dimensions of Egede's ship are not known.

with large flippers, of which two were seen, is something that is biologically possible. (It might be added that Egede also described and pictured several varieties of whales to be found off the coast of Greenland; therefore, his sea serpent cannot have been a whale, as has been suggested.) Under no circumstances does it fall into the same class as Olaus's famous "midnight marvels" which Gesner reproduced but declined to be held responsible for.

The very next eyewitness report after Egede's takes the last remnants of "otherworldliness" out of sea serpents. This report dates from a day near the end of August 1745. It was made by Commandant Lorenz von Ferry and was preserved in the *Natural History of Norway* by the famous Erik Pontoppidan. Commandant von Ferry was traveling in a small sailing vessel from Trondhjem to Molde, along the coast of Norway. The day was very hot, the sea smooth as a mirror, and the air completely calm. When they were still about a mile from Molde:

> I heard a kind of murmuring voice from amongst the men at the oars, who were eight in number, and observed that the man at the helm kept off from the land. Upon this I inquired what was the matter, and was informed that there was a sea serpent ahead of us. I then ordered the helmsman to keep the land again, and to come up with the creature, of which I had heard so many stories. Though the fellows were under some apprehensions, they were obliged to obey my orders.
>
> In the meantime the sea snake passed by us, and we were obliged to turn the vessel about in order to get nearer to it. As the snake swam faster than we could row, I took my gun, which was loaded with small shot, and fired at it; on this it immediately plunged under water. We rowed to the place where it sank down (which in the calm might be easily observed) and lay upon our oars, thinking it would come up again to the surface; however, it did not. Where the snake plunged down, the water appeared thick and red; perhaps the small shot might have wounded it, the distance being very little.

If this report had been written by Olaus Magnus, he would probably have told how the sea serpent seized and devoured at least four of the crew of eight. Actually nothing happened. The animal, upon discovering itself attacked, simply disappeared under the sea. This type of behavior is also noted by a number of later reports. It seems that the Great Unknown of the Seas pays surprisingly little attention to the

ships and boats of man. Again, the weather was good and the sea calm. There might after all be some connection between the hot days of summer and the sea serpent, but in a sense other than has often been jokingly asserted.

The next important chapter in the story of the Great Unknown of the Seas appears under the title of the "New England Sea Serpent of 1817." This chapter exhibits many of the perennial elements of the history of the sea serpent: first, a number of sincere and generally trustworthy reports; second, a confession of inability to explain what has been observed; third, a complete absence of the kind of conclusive evidence nonobservers like to have, which, in the case of the sea serpent, must be nothing less than a captured specimen, dead or alive —preferably the latter; and, finally, a fearful blunder which provided an excellent excuse for poking fun at the unfortunate people who had enough backbone to insist that they had actually seen what they had described.

The locality frequented by the New England sea serpent was Massachusetts Bay, especially the harbor of Gloucester; and the whole matter of its investigation was handled very expertly (save for the last-minute blunder) by a committee appointed by the Linnaean Society of Boston. This committee laid down some rules to guide its research: it would examine only persons who claimed to have seen the creature for themselves; these persons were to give their testimony in writing, either before the committee or before the Honorable Lonson Nash, Justice of the Peace; and they must answer twenty-five questions prepared in advance by the committee.

The earliest date obtained in these statements is that of a mariner named Amos Story who saw the "strange marine animal" for the first time in the harbor of Gloucester on August 10, 1817. Story was also the last witness, for he saw it again (apparently while it was asleep) early in the morning of August 23, 1817. As an example of the general tenor of these affidavits, that of Shipmaster Solomon Allen may be quoted in part:

> I, Solomon Allen 3d, of Gloucester, in the County of Essex, Ship master, depose and say; that I have seen a strange marine animal, that I believe to be a serpent, in the harbor in said Gloucester.

I should judge him to be between eighty and ninety feet in length, and about the size of a half-barrel, apparently having joints from his head to his tail. I was about one hundred and fifty yards from him, when I judged him to be of the size of a half-barrel. His head formed something like the head of the rattle snake, but nearly as large as the head of a horse. When he moved on the surface of the water, his motion was slow, at times playing about in circles, and sometimes moving nearly straight forward. When he disappeared, he sunk apparently directly down, and would next appear at two hundred yards from where he disappeared, in two minutes. His color was a dark brown, and I did not discover any spots upon him.

This mysterious ability to sink "directly down" is also mentioned in the affidavit of Matthew Gaffney, one of the men that tried to settle the sea serpent problem with a gun:

I, Matthew Gaffney, of Gloucester in the County of Essex, Ship carpenter, depose and say: That on the fourteenth day of August, A.D. 1817, between the hours of four and five o'clock in the afternoon, I saw a strange marine animal, resembling a serpent, in the harbor in said Gloucester. I was in a boat, and was within thirty feet of him. . . . I fired at him, when he was the nearest to me. I had a good gun, and took good aim. I aimed at his head, and think I must have hit him. He turned towards us immediately after I had fired, and I thought he was coming at us; but he sunk down and went directly under our boat, and made his appearance at about one hundred yards from where he sunk. He did not turn down like a fish, but appeared to settle directly down, like a rock. . . .

Lonson Nash, who officially collected all these affidavits, was also one of the witnesses. He saw the mysterious animal twice through a glass, for a short time, and at other times with the "naked eye."

All in all, the animal was seen for several weeks by many hundreds of people, at ranges varying from twenty feet to two miles. That all these people should have banded together to perpetrate a hoax is wellnigh impossible. There can be no doubt that *something* was swimming around in Massachusetts Bay in August 1817. Many plans were made to kill or capture the animal, but the time was apparently too short to put these plans into operation.

One point that keeps cropping up in these New England reports (and in other reports as well) is that of "humps" or "bunches" on the back of the animal. This feature was emphasized again later on in the

accounts of the Reverends Twopenny and Macrae from Loch Hourn in Scotland and also in the Loch Ness reports, although it is rarely mentioned in observations made on the high seas. It seems that the back of the Great Unknown shows (or may form under special circumstances) a series of bunches. There is no agreement as to their number, but eight or ten seems to be a fair average. It is likely that these bunches, whatever they may be, are responsible for the name of sea *serpent,* being interpreted as the visible parts of the coils of a gigantic snake. Such an explanation is, of course, nonsense, if only for the reason that no snake moves in vertical coils as some caterpillars do. In fact, there are reports that mention these bunches and horizontal loops in the same breath.

It was because of these bunches that the sea serpent committee of the Linnaean Society of Boston committed the blunder in its investigation to which I have already referred. The learned members must have wondered considerably about the humps, or serrations, as they preferred to call them, and when a man of the name of Beach brought them a three-foot snake with a number of small humps on its back they believed they had ample reason for feeling elated. The snake had been found and bravely slain near Cape Ann, about a month after the sea serpent had left Gloucester harbor.

It should be remarked that the date of departure of the serpent is fairly well established. Amos Story, the last of the Gloucester witnesses, saw it on August 23; but five days later an animal of the same type was observed two miles east of Cape Ann by the captain and crew of the schooner *Laura.* It seems reasonable to conclude that it was the same animal; and it is probable that two sea serpent reports from Rye Point on Long Island Sound, dating October 3 and October 5, 1817, also refer to the same individual.

To go back to the committee of the Linnaean Society, the residents of Gloucester had agreed among themselves as to the reason they had been visited by the sea serpent. Most probably it had to come to shore, like the big marine turtles, to deposit its eggs. Some lucky person might find the eggs and settle the question. If anyone looked for sea serpent eggs—as many doubtless did—he did not mention it, to avoid ridicule. Whether the boy who found the three-foot humped snake and the

man, his father, who slew it with a pitchfork thought of a "young sea serpent" at once is doubtful; but they must have thought along these lines later on, else they would not have presented the Linnaean Society with the cadaver. The members of the committee did not reject this suggestion; when they found a number of small humps on the back of the snake they accepted it with joy. Without hesitation they stated that their three-foot specimen and the observed seventy-foot creature agreed in every respect, except in size, and that they "felt justified in considering them individuals of the same species." They gravely named it *Sciolophis atlanticus* and published two plates illustrating it. Then every expert saw at once that the "young sea serpent" had been a slightly diseased common black snake.

It was a bad blow. A committee that made such a mistake did not seem very trustworthy in other respects. Consequently the sea serpent, inexplicable as it was, was quickly termed "American humbug" and disregarded by men of science, while a few practical jokers thought this a good opportunity for some juicy sea serpent hoaxes.

The most famous of these, the "mystery of the fossil sea serpent," was perpetrated in New York in the early summer of 1845. "Dr." Albert C. Koch exhibited on Broadway a large skeleton of a fossil animal, labeled *Hydrarchus sillimanni*. Koch claimed that, though extinct, it was most certainly related to the sea serpent of our present time, and was probably an ancestor of the present group or family. The skeleton certainly looked it. It was 114 feet long, definitely of serpentine form, consisting mainly of a long row of vertebrae. It had a small head, a number of short ribs and incomplete paddles. It was mounted in a slightly "wavy" position with reared-up head, a position familiar to Koch from many sea serpent reports.

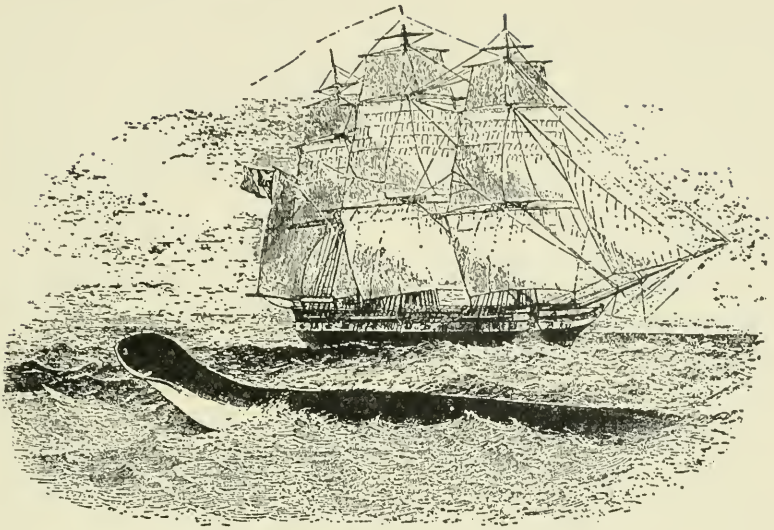
Many New Yorkers came and paid good silver pieces to marvel at the fossil wonder and listen to Koch's lectures. Unfortunately for "Dr." Koch, one of his visitors really studied the fossil bones. Professor Wyman happened to be an expert zoologist and anatomist; he soon published an article in the *Proceedings of the Boston Society of Natural History* (November 1845) proving that "these remains never belonged to one and the same individual, and that the anatomical characteristics of the teeth indicate that they are not those of a reptile but of a warm-

blooded mammal." Professor Wyman also succeeded in discovering what fossil animal had furnished the bones; it was zeuglodon, an extinct distant relative of the present-day whales. Koch had stated—truthfully, for once—that he had collected the bones in Alabama, where remains of zeuglodon have actually been discovered repeatedly. Professor Wyman believed that two individuals of zeuglodon had been pieced together; this explanation later proved to be an understatement: Koch had strung together as many zeuglodon vertebrae as he could find.

After his hoax had been exposed Koch packed his *Hydrarchus sillimanni* in solid wooden boxes and shipped it to Dresden. But his glory did not last long there either; the fraud was exposed again. In addition, the famous British paleontologist Gideon A. Mantell shed some light on "Dr." Koch's past in a letter published by the *Illustrated London News*. After explaining how the Broadway skeleton had been manufactured, Mantell continued:

> Mr. Koch is the person, who, a few years ago, had a fine collection of fossil bones of elephants and mastodons, out of which he made up an enormous skeleton, and exhibited it in the Egyptian Hall, Piccadilly, under the name of *"Missourium."* This collection was purchased by the trustees of the British Museum and from it were selected the bones which now constitute the skeleton of the Mastodon. . . .

While Koch's fossil sea serpent, though impressive, was rather short-lived, another earlier sea serpent hoax had an exceedingly long life. Shortly after the Linnaean Society of Boston had busily collected eyewitness reports of the New England sea serpent of 1817, a Captain Joseph Woodward—he was probably as much a captain as Koch was a doctor—arrived with an exciting sea serpent yarn. He asserted that in May 1818 his ship, sailing in New England waters, suddenly encountered a huge sea serpent. When it first appeared, it was about sixty feet from the ship and came closer with astonishing speed. They fired a small cannon ball and a number of musket bullets against the monster and heard them strike, but the animal moved on unaffected. "Captain" Woodward ordered the cannon to be loaded again, but before they could be fired his men became badly frightened and ran for shelter.



The *Daedalus* sea serpent
(From *The Illustrated London News,* October 28, 1848)

A crash between the ship and sea serpent seemed inevitable, but Woodward succeeded in tacking so as to avoid the animal that afterwards continued to pursue them for five hours!

Now, if there ever was a story that has the word "hoax" spread over its entire length, it is this one. But, strange to say, it met with much more success than dozens of simple and sincere reports. After being published in several Boston and New York newspapers, it was reprinted by the *Quarterly Journal of Science, Literature, and the Arts* of the Royal Institute at London (Vol. VI, 1818), then in Oken's *Isis,* and again, *thirty years later,* in *The Zoologist* (1848), without mention of the source. From there it was translated into German by Froriep for his journal *Notizen,* and it might have continued to haunt newspapers and journals if W. W. Cooper had not taken pains to examine the evidence and to expose it.

Soon afterward the sea serpent story took on a radically new aspect. In zoological literature the case responsible for this is known as that of "the *Daedalus* serpent." The date is August 6, 1848. Her Majesty's Ship

Daedalus, under Captain Peter M'Quhae, was returning from a voyage of duty in East Indian waters and had reached a point in the South Atlantic somewhere between the Cape of Good Hope and the island of St. Helena. There, in a fresh breeze and with almost all the canvas up, she must have presented a beautiful picture, but romantic adventure was furthest from the minds of those on board. As for sea serpents, they might be encountered in the arctic twilight off the Norse coast or in the harbors of credulous or exaggerating Yankees, but not by one of Her Majesty's men-of-war on routine duty. For the true Britisher the serious side of the sea serpent controversy begins on August 6, 1848, and the evidence of it may be found on official British stationery:

Sir,—In reply to your letter of this day's date, requiring information as to the truth of a statement published in *The Times* newspaper, of a sea-serpent of extraordinary dimensions having been seen from Her Majesty's ship *Daedalus,* under my command, on her passage from the East Indies, I have the honour to acquaint you, for the information of my Lords Commissioners of the Admiralty, that at 5 o'clock p.m. on the 6th of August last, in latitude 24° 44′ S., and longitude 9° 22′ E., the weather dark and cloudy, wind fresh from the N.W., with a long ocean swell from the S.W., the ship on the port tack heading N.E. by N., something very unusual was seen by Mr. Sartoris, midshipman, rapidly approaching the ship from before the beam. The circumstance was immediately reported by him to the officer of the watch, Lieut. Edgar Drummond, with whom and Mr. William Barrett, the Master, I was at the time walking the quarter-deck. The ship's company were at supper.

On our attention being called to the object it was discovered to be an enormous serpent, with head and shoulders kept about four feet constantly above the surface of the sea, and as nearly as we could approximate by comparing it with the length of what our main-topsail yard should show in the water, there was at the very least 60 feet of the animal *à fleur d'eau,* no portion of which was, to our perception, used in propelling it through the water, either by vertical or horizontal undulation. It passed rapidly, but so close under our lee quarter, that had it been a man of my acquaintance I should have easily recognized his features with the naked eye; and it did not, either in approaching the ship or after it had passed our wake, deviate in the slightest degree from its course to the S.W., which it held on at the pace of from 12 to 15 miles per hour, apparently on some determined purpose.

The diameter of the serpent was about 15 or 16 inches behind the head,

which was, without any doubt, that of a snake, and it was never, during the 20 minutes that it continued in sight of our glasses, once below the surface of the water; its colour a dark brown, with yellowish white about the throat. It had no fins, but something like a mane of a horse, or rather a bunch of seaweed, washed about its back. It was seen by the quartermaster, the boatswain's mate, and the man at the wheel, in addition to myself and officers above mentioned.

This letter was addressed to Admiral Sir W. H. Gage. Everyone at once became profoundly interested, and a number of drawings, made by an artist of the *London Illustrated News* under the personal supervision of Captain Peter M'Quhae, were regarded (by the majority of the readers of this journal) as the first authentic pictures of the unknown monster. Further excitement was added when a few zoologists, who in all probability had fewer hours at sea to their credit than Captain M'Quhae or Admiral Gage had days, felt obliged to criticize. Leader in the fight against the *Daedalus* serpent was the distinguished, but at that time already somewhat elderly and garrulous, Professor Richard Owen. The direct result of the controversy was *nil*. Captain M'Quhae would not admit that he had failed to see what he had seen, while Professor Owen would not admit that Captain M'Quhae had seen what he had seen. The indirect result, however, was the publication of a number of earlier observations.

One of these goes under the name of the "*Lady Combermere* sea serpent," from the vessel from which the unknown animal was observed. The case had been put in writing in about 1820 (apparently immediately after the encounter) by Lieutenant George Sandford, commander of the vessel. Lieutenant Sandford kept a private memorandum book in which the story was discovered after his death by a Dr. Scott. The sea serpent had been seen in the North Atlantic, near Barencthy's Rocks in Lat. 46° N., Long. 37° W. The animal was "between 70 and 100 feet" long, and when the vessel approached, "it reared head and neck out of the water and after taking a survey it all at once vanished."

Another published report is that of the *Royal Saxon*. In this account the animal was seen in 1829 by the captain of that ship and by Dr. R. Davidson, a surgeon of the Nagpore Subsidiary Force, and by a number of other persons on deck at that time. The serpent, to quote Dr.

Davidson's words, "passed within 35 yards of the ship, without altering its course in the least; but as it came right abreast of us, it slowly turned its head towards us." Dr. Davidson later concluded that this must have been the same kind of animal as that seen twenty years afterwards by Captain M'Quhae of the *Daedalus,* but a somewhat larger specimen.

Another observation was made on May 15, 1833, by five officers on a fishing trip about twenty miles off Halifax.

> At the distance of from 150 to 200 yards on our starboard bow, we saw the head and neck of some denizen of the deep, precisely like those of a common snake, in the act of swimming, the head so far elevated and thrown forward by the curve of the neck as to enable us to see the water under and beyond it. The creature passed, leaving a regular wake. . . . There could be no mistake, no delusion. . . .

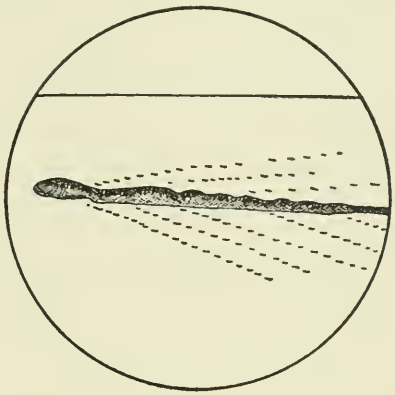
That these officers were perfectly willing to accept full responsibility they indicated by signing the report with name and rank:

W. Sullivan, Captain, Rifle Brigade
A. Maclachlan, Lt., Rifle Brigade
G. P. Malcolm, Ensign, Rifle Brigade
B. O'Neal Lyster, Lt., Artillery
Henry Ince, Ordnance Storekeeper at Halifax.

Very significant, in my opinion, although deplorably lacking in detail, is the story of Captain George Hope of H.M.S. *Fly,* published in 1849 in the British journal *Zoologist.* Captain Hope was the first who saw not only a part of the strange animal, but all of it. He encountered his sea serpent in the Gulf of California. The sea was perfectly calm and transparent, and he saw through the clear water a large animal moving along the bottom. It had the head and general shape of an alligator, but differed in two important features. The neck of the unknown animal was much longer than that of an alligator, and instead of having four legs the creature displayed four large flippers that moved like those of the large marine turtles. Captain Hope saw distinctly that the front flippers were much larger than the hind ones, which was to be expected of an animal that swims by means of flippers.

All these observations antedated the *Daedalus* sea serpent, although they were not published until Captain M'Quhae "broke the ice." But

there was no dearth of new encounters after the *Daedalus* adventure. On December 31, 1848, for instance, H.M.S. *Plumper* fell in with such an animal west of Oporto. Again, on March 30, 1856, the captain and a few passengers of the ship *Imogen* observed one in the English Channel for about forty minutes. Captain G. H. Harrington of the ship *Castilian* reported sighting one in the Atlantic Ocean, ten miles northeast of St. Helena, on December 12, 1857. In August 1872 the Reverend



The *Imogen* sea serpent, as seen by Captain James Guy through a spyglass on March 30, 1856, in the English Channel

Mr. John Macrae and the Reverend Mr. David Twopenny on a sailing trip from Glenelg to Loch Hourn observed a sea serpent from on board their boat in the Sound of Sleat on the west coast of Scotland. The two reverend gentlemen were not the only observers of this animal; for several days many other persons saw it from various points along the shores of Loch Hourn.

A distinguishing feature of the Loch Hourn reports is again the mention of "lumps" or "bunches" or, as one of the observers put it, "half-rounds"—more precisely, "hemi-elliptical protuberances." The Reverend Mr. Macrae wrote:

> Sometimes three appeared, sometimes four, five or six, and then sank again. When they rose, the head appeared first, if it had been down, and

the lumps rose after it in regular order, beginning always with that next to the head, and rising gently; but when they sank they sank all together rather abruptly, sometimes leaving the head visible. It gave the impression of a creature crooking up its back to sun itself. There was no appearance of undulation; when the lumps sank, other lumps did not rise in the intervals between them. The greatest number we counted was seven, making eight with the head. The parts were separated from each other by intervals of about their own length.

Another point emphasized in this report is that the animal, if it wants to, can "rush through the water at great speed."

Early on the evening of June 2, 1877, Captain H. L. Pearson of the royal yacht *Osborne* and several of his officers saw a very large animal swimming away from their vessel at a distance of about four hundred yards. The head, large shoulders, and two enormous flippers could be seen. An official report was made to the Admiralty. It finally landed on the desk of Professor Richard Owen, who, then seventy-three years old, did not see any reason to revise his opinion that there was no such animal as a sea serpent and who wrote a "criticism" of several pages which might be condensed into the sentence: "The observers have no expert knowledge of zoology; their observation is, therefore, without value."

At this point it is perhaps well to interrupt the recitation of reports for a while and to summarize the general shape of the creature as it may be gathered from these observations. Captain Hope presented the first and most precise description: an animal of the "general shape of an alligator," but with a neck "much longer than that of an alligator," and four large flippers instead of legs. None of the other reports, from Egede's down to the latest stories from Loch Ness, contains elements that contradict this description. Sometimes only the neck was seen, sometimes only two of the four flippers or the line of the back and the tail, but none of the other observations adds features that could not be applied to an animal of the general shape of that seen by Captain Hope.

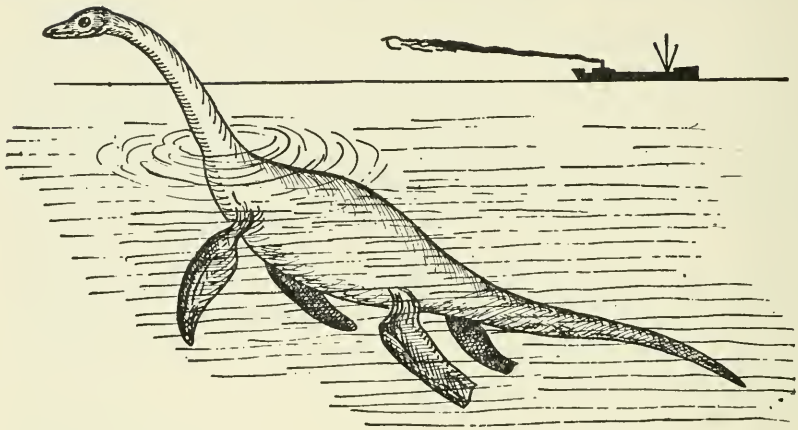
The reports mentioning color all agree that the back was dark (dark brown, dark gray, or black), while the belly and the underside are generally described as light (white or yellowish). This coloration is

also what might be expected from a marine animal. The greatest discrepancies concern size. Some reports, especially recent ones, speak of small animals with an over-all length of fifteen to twenty-five feet. The majority of all the observations agree on a total length of about sixty to eighty feet, and only a very few mention larger figures. Now the average, sixty to eighty feet, is comparable to the measurements of a whale of the larger varieties and may be believed without too many scruples. In fact, a sixty-foot sea serpent would actually be a smaller animal than a sixty-foot whale, which is very massive, for the sea serpent has a long, slender neck and a very long tail. One interpreter put it very nicely in saying that the sea serpent compares to the whale as the giraffe compares to the elephant.

If we have agreed so far, we may ask ourselves what type of animal might be expected to have this appearance and these dimensions. The sea serpent is most decidedly not a fish and it also is certainly not an amphibian. Amphibians do not live in salt water, and there exists no fossil evidence that they ever did. The choice therefore lies between reptiles and mammals.

The vast majority of those authors and scientists who, to use the words of Professor E. C. Boulenger, Director of the London Zoological Society's aquarium, gave the sea serpent "the benefit of the doubt," decided that in all probability it would be a reptile. They had in fact a very simple and plausible theory to back up this decision. About eighty million years ago, during the Cretaceous Period, which coincides with the last part of the Age of Reptiles, there was no lack of sea reptiles of various kinds. No less than three different groups of them are known to have existed in that period. Therefore, the defenders of the sea serpent simply had to assume the survival of a few such saurians, and the whole puzzling and slightly annoying problem seemed solved. True, those who opposed this solution pointed out that the remains of Cretaceous sea serpents are never found in rocks dating later than the period of their glory; but we know now that this argument is not conclusive, for the fish *Latimeria,* which still lives, is much older than all the dinosaurs, and yet we do not know any fossil remains of it that are younger than the age of the dinosaurs.[1]

[1] See Chapter 15.



Sea serpent, modern conception: a composite of the majority of the reports, omitting the mane and the dorsal fin

There is, however, another point that speaks rather strongly against the simple theory of dinosaurs still living in the ocean. Of the three different groups of Cretaceous sea reptiles mentioned above, not one quite fits the descriptions of the modern sea serpent. The first group, the mosasaurians, were long and slender dragons of the high seas, with terrifying teeth and presumably astonishing agility. They looked like enormous eels with four powerful flippers. They varied in length from ten to sixty feet.

The name of *Mosasaurus* is purely geographical. It was bestowed upon this group because the first fossil remains were found on the slope of the Petersberg, near Maastricht in the Netherlands, on the banks of the river Meuse. The story of the discovery of these first Meuse-dragons —as the name mosasaurians may be translated—sounds as if it were invented in Hollywood and is worth this interruption in our examination of evidence.

The discoverer of the fossil skull was a physician named Hoffman, who found it in a quarry in 1770. It was a rather large piece, and Dr. Hoffman had to spend considerable money to have it removed from its site and brought to his place. Naturally the find attracted attention, and M. Godin, a priest who owned the quarry, claimed it to be his

property. Dr. Hoffman denied this, and M. Godin sued for recovery and won. But not for long. A few years later war broke out, and when in 1795 the soldiers of the revolutionary French Republic attacked the city, their general issued a special order that M. Godin's residence was not to be bombarded. After the battle, a special detachment of the victorious French army was sent to M. Godin's house to pick up the fossil dragon. They arrived too late; Godin one night had had it removed to a safe place. Then Citizen Freicine, representative of the French Republic, offered a reward for the rediscovery of the skull, not in cash—for the currency was regarded with much suspicion—but in the form of six hundred bottles of wine. Exactly twelve hours after the posters had been put up, a dozen soldiers, perspiring but happy, carried the load of fossil bones into the representative's house. They got their wine, the Institute in Paris (where Cuvier examined and described it) got the coveted skull, and Citizen Freicine was probably promoted.

To return to the sea serpent, the long, eel-like, swift, and ferocious mosasaurian would make a perfect one if it were still alive; but unfortunately it does not fit the descriptions of modern reporters. "Our" sea serpent has as its most outstanding and most frequently observed feature a long neck—and the mosasaurian does not. A second group of Cretaceous reptiles would do much better as far as the neck is concerned. These are the well-known plesiosaurians, which, by reason of their long necks, are actually referred to as "swan dragons." Swimming on the surface they must have looked from a distance like gigantic black swans. Again, however, there is something lacking, this time at the other end. The modern sea serpent seems to have a fairly long tail, while the tail of the plesiosaur was extremely short.

The third group, which actually approaches the picture of the sea serpent most closely, is one that is known to almost everyone and called by scientists the sauropod dinosaurs. One of these dinosaurs lurks on the advertising billboards along every highway in the United States. It is *Brontosaurus,* the "thunder lizard." I have been told, though I do not accept responsibility for the authenticity of the story, that in India there is a legend of a gigantic snake that swallowed an elephant whole. The elephant proved to be too big a bite, and its four legs burst out of the body of the snake and began to walk away. This legend provides a per-

fect description of the outward appearance of *Brontosaurus*—a long and snake-like neck and an equally long and powerful tail, attached to the body of an elephant.

Brontosaurus was certainly large enough to satisfy all the requirements as to size that were ever made by observers of the sea serpent. From the tip of its snout to the tip of its tail, *Brontosaurus* ranged from fifty to eighty feet, with an estimated weight of twenty tons. It lived in shallow lakes and streams, where the water helped to carry the enormous weight of the body. For a while a large number of scientists even believed that *Brontosaurus* and the other large sauropod dinosaurs could not live at all outside of those small streams and lakes. A *Brontosaurus* in a dried-up lake, the theory ran, was just twenty tons of helpless bone and meat, unable to move its weight without the support of water. Fossil footprints found recently in the Southwest have, however, disproved this supposition. They show that *Brontosaurus* was not only *able* to walk on dry ground, but that it *did* walk, presumably from one lake to another, on occasion. Of all the Cretaceous reptiles, this one would best fit the given descriptions of the sea serpent, except that *Brontosaurus* had legs much like those of an elephant, while the sea serpent has paddles.

Occasionally it has been suggested that the sea serpent may well be a living fossil but of a species we do not know and not necessarily a reptile. The ancestors of our whales were a group of marine mammals known as zeuglodons. Zeuglodon—whose remains we have already encountered in "Dr." Koch's *Hydrarchus*—was not as massively built as the whale of today; indeed, it bore a superficial resemblance to mosasaurus, except that it had only front flippers, the hind ones having already been discarded in that early stage of whale history. This means, of course, that, since zeuglodon lacked not only the long neck but also the hind flippers, it fits the picture of the sea serpent even less than the suggested three groups of reptiles.

It was Professor A. C. Oudemans who took the inevitable step of "inventing" an animal to fit the cross-section of the descriptions rendered by eye-witnesses. He drew a picture, somewhat *Brontosaurus*-like in outline, but with flippers instead of legs, and announced that such an animal could account for almost every report. Professor Oudemans felt con-

fident, for a number of reasons, that his hypothetical animal was not a reptile but a mammal, "a huge pinniped," to use his own words. While the evidence he cited in support of the mammalian nature of his animal is somewhat flimsy and sketchy, it nevertheless seems that he was right. Those observations of sea serpents in icy waters are more credible if a mammalian nature is assumed.

Only two months after the publication of Professor Oudemans' book another report was made which gloriously confirmed his contentions as to the true shape of the sea serpent.

Log of the S.S. *Umfuli* from London towards Natal, Monday, Dec. 4th, 1893.

P.M.

2 Calm & smooth sea

4 Same weather P.L. 43 [1]

5:30 Sighted and passed about 500 yards from ship a Monster Fish of the Serpent shape, about 80 ft. long with slimy skin and short fins at about 20 feet apart on the back and in cir. [circumference] about the same dimension of a full sized whale. I distinctly saw the fish's mouth open & shut with my glasses. The jaw appeared to me about 7 feet long with large teeth. In shape it was just like a Conger Eel.

C. A. W. Powell, Mate.

To the information rendered by this page from the *Umfuli's* log it may be added that the ship was approximately at Lat. 21° 40′ N. (about the latitude of Havana) and Long. 17° 30′ W., off the west coast of Africa. She was steaming southward on her way to the Cape of Good Hope with a speed of ten and one-half knots and carried eighty passengers. The *Umfuli's* commander, Captain R. J. Cringle, felt obliged to write a report of his encounter with the Great Unknown of the Seas which contains the following paragraphs:

It was rushing through the water at great speed, and was throwing water from its breast as a vessel throws water from her bows. I saw full 15 ft. of its head and neck on three several occasions. The body was all the time visible. . . . The base, or body, from which the neck sprang, was much thicker than the neck itself, and I should not, therefore, call it a serpent. Had it been breezy enough to ruffle the water, or hazy, I should

[1] P.L. means patent-log, showing a run of 43 miles since noon at the end of the watch.

have had some doubt about the creature; but the sea being so perfectly smooth, I had not the slightest doubt in my mind as to its being a sea-monster.

I turned the ship round to get closer to it, and got much nearer than we were at first; but the sun was then setting and the light gone, so that to have run the ship further off her course would have been folly. . . . This thing, whatever it was, was in sight for over half an hour. In fact we did not lose sight of it until darkness came on.

When Captain Cringle's account became known (in 1895) many scientists still maintained the attitude that had been introduced a few decades earlier by the rather difficult Professor Richard Owen. Sea serpent reports were not for discussion but were something to sneer at, no matter who made them. Small wonder that Captain Cringle complained in a letter to Rupert T. Gould:

I have been so ridiculed about the thing that I have many times wished that anybody else had seen that sea-monster rather than me. I have been told that it was a string of porpoises, that it was an island of seaweed, and I do not know what besides. But if an island of seaweed can travel at the rate of fourteen knots, or if a string of porpoises can stand 15 ft. out of the water, then I give in. . . .

From then on until after the First World War things remained comparatively quiet. Not that there were no observations, but they did not create much of a stir. Since critics did not say much, Professor Oudemans' book must have made a deeper impression than was believed at that time.

In addition there appeared one observation that was especially unpleasant to those who tried by means of ridicule to fend off the realization of having been in error. As long as "only" sea captains and ministers had reported encounters with sea serpents, it had been convenient to say that they were honest men, of course, and sincere in their efforts to describe something they did not know, but, after all, they were not naturalists. Professor Oudemans was a naturalist, yes, but he had not seen the sea serpent. He probably never would see one, because he would recognize the "monster" for what it really was: seaweed or schools of porpoises or whales. He, as a zoologist, would not be handicapped by "excessive imagination," "insufficient scientific knowledge," "lack of training in ob-

servation," and whatever else armchair scientists had had to say about Hans Egede, Commandant von Ferry, Captain M'Quhae, and Captain Cringle.

But now came one report about which all these things could not be said. The critics all quickly agreed, without even having to ask one another's opinion, that it was by far best to say nothing about it at all. Therefore, that whole chapter in the story of the sea serpent is intensely disliked by skeptics, and, if humanly possible, not quoted by them at all.

But there it is, printed in the *Proceedings of the Zoological Society* (London 1906), pages 719-721, signed by E. G. B. Meade-Waldo and Michael J. Nicoll. Both gentlemen were naturalists by profession, Fellows of the Zoological Society, and they report having encountered a sea serpent while on a scientific expedition.

On Dec. 7th, 1905, at 10:15 A.M., I was on the poop of the *Valhalla* with Mr. Nicoll, when he drew my attention to an object in the sea about 100 yards from the yacht; he said: "Is that the fin of a great fish?"

I looked and immediately saw a large fin or frill sticking out of the water, dark seaweed-brown in colour, somewhat crinkled at the edge. It was apparently about 6 feet in length and projected from 18 inches to 2 feet from the water.

I got my field-glasses on to it (a powerful pair of Goerz Trieder), and almost as soon as I had them on the frill, a great head and neck rose out of the water in front of the frill; the neck did not touch the frill in the water, but came out of the water in front of it, at a distance of certainly not less than 18 inches, probably more. The neck appeared about the thickness of a slight man's body, and from 7 to 8 feet was out of the water; head and neck were all about the same thickness.

At the time of the encounter the *Valhalla* was cruising off Parahiba, Brazil. She was owned by the Earl of Crawford, who, for reasons of health, had to spend the winter in a warm climate. He made long cruises in Southern waters with his yacht, taking scientists along to give them an opportunity for research work.

The question why they did not make an attempt to follow the creature (the *Valhalla* was, after all, not bound to any schedule) was answered by Mr. Meade-Waldo in a letter to R. T. Gould:

The color was dark seaweed brown; the frill at the back of the head and along the back crinkled at the edge. About 8 ft. of neck was out of

the water, and the under side was dirty white. It made a wave as it went along, and under water behind the neck I could see a good-sized body. As we drew ahead we could see it swing its neck from side to side and it lashed the sea into foam.

The eye and the edge of the neck had a turtle-like appearance to us both. We were so astonished at the time that we could neither of us speak! We then visited (late) Lord Crawford, and he said he would stop the yacht if it was any use; but we decided as we were making about 14 knots it would not be much use.

The creature seen from H.M.S. *Daedalus* . . . might easily be the same.

Mr. Nicoll's report for the *Proceedings* was about the same as Mr. Meade-Waldo's; only one statement might be of further importance:

This creature was an example, I consider, of what has been so often reported, for want of a better name, as the "Great Sea-Serpent." I feel sure, however, that it was not a reptile that we saw, but a mammal. It is, of course, impossible to be certain of this, but the general appearance of the creature, especially the soft, almost rubber-like fin, gave one this impression.

This is one of the very few reports that mention a fin. Older reports had spoken of a "mane," but many had specifically denied that they had seen a mane. Professor Oudemans had placed faith in both reports, assuming that the maned individuals were males. Such an assumption is not farfetched; only the male narwhal, for example, sports the single long "unicorn horn." Whether a similar assumption can be made about the fin I dare not say, but fin or no fin, two expert zoologists saw a large marine animal they did not know and which they declared to be the same that others had called the sea serpent.

One other report which mentions a dorsal fin is that of Captain F. W. Dean, R.N., of the armed merchant cruiser *Hilary*. Place and date of the encounter: the North Sea, some seventy miles to the southeast of Iceland, May 22, 1917. The *Hilary* was taking part in the North Sea blockade, and the encounter between these two, the mysterious Great Unknown and the armed merchant cruiser, was a dramatic one. Captain Dean's *Hilary* was torpedoed by a German submarine only three days later; but fortunately he escaped with his life and was able to tell the story of his battle with the sea serpent, which took place within sight of Iceland's famous mountain Oraefajökull.

Here is the greater part of the story, as Captain Dean published it in *Herbert Strang's Annual,* 1920 (London):

After a stormy winter we enjoyed some wonderfully fine weather during May 1917. On the morning of, I think, the 22nd the conditions were perfect—brilliant sunshine and not a cat's paw to ruffle the sea. Beyond the horizon to the northward the peaks of Iceland could be seen, the only breaks in our all-round view of sea and sky.

It was about 9 A.M., and I was sitting at the writing-table in my cabin, which was immediately under the bridge, when a report was shouted down to me: "Object on the starboard quarter." In three seconds I was on the bridge asking, "Was it a periscope? Where is it?"

"No, not a periscope," replied the officer of the watch. "It looks more like a living thing, but it is not a whale," and he pointed at an object which at first glance suggested to my mind a tree trunk with only the knobby ends (from which branches and roots had been cut) visible. A careful look through my glasses, however, made it clear that the thing was alive, and that the "knobby ends" were in fact its head and dorsal fin.

We never missed a chance in those days to do a bit of anti-submarine practice, and it at once struck me that here was a good target; so I turned to the 1st lieutenant, Lieutenant-Commander Charles M. Wray, R.N.R., and told him to get our three 6-pounder guns' crews up, so that each one in turn should have a run. Like most of the armed merchant cruisers on that patrol, we had, in addition to our heavier guns, two 6-pounders placed one each side, just abaft the bridge, and part of our defence scheme was to have three guns' crews, one of which was always on watch between these two guns, ready to close up instantly starboard or port, according to which side a submarine might be sighted. . . .

Before taking the liberty of using the stranger as a target, however, I thought it would be a good thing to have a closer look at it, so told Lieutenant Harris, the navigator, to turn the ship round and head towards it. In due course we approached our object end on, and when we were about a cable from it, it quietly moved out of our way, and we passed it about thirty yards off on our starboard side, getting a very good view of it while doing so.

The head was about the shape of, but somewhat larger than that of, a cow, though with no observable protrusions such as horns or ears, and was black, except for the front of the face, which could be clearly seen to have a strip of whitish flesh, very like a cow has, between its nostrils. As we passed, the head raised itself two or three times, apparently to get a good look at the ship. From the back of the head to the dorsal fin no part of the creature showed above water, but the top edge of the neck was just level

with the surface, and its snake-like movements could be clearly seen. (It curved to almost a semi-circle as the creature moved its head round as if to follow us with its eyes.)

The dorsal fin appeared like a black triangle, and when the creature was end on, this fin was seen to be very thin and apparently flabby, as the upper part turned over sometimes like the top of a terrier's ear when cocked. The fin was estimated to be about four feet high when in the position highest out of the water.

I was anxious to get as good an estimate as possible of the length of the neck, i.e., the distance from the head to the fin, so asked the 1st lieutenant, the navigator and the officer of the watch each to note, as I did, the length, and we compared with following results:

1st Lieutenant.—"The length of one of our boats."

Navigator.—"Not less than fifteen feet."

Officer of Watch.—"Length of one of our boats."

Myself.—"Twenty feet."

From which it may fairly be assumed that the true length of the neck was probably not less than twenty feet; and, assuming that the dorsal fin would be just behind the junction of neck and body, the total length of the creature would be about 60 feet.

The creature did not seem to be in the least alarmed by the presence of the ship, but continued to bask on the surface, now sinking down till only the tip of its nose and fin were visible, and anon rising again till the whole head and the fin to a height of four feet were above water.

The ship was steaming at twelve knots all the time, so the creature was soon 1000 yards astern, and we then turned around, and I gave the order, when the range was approximately 1200 yards, for the first gun's crew to fire five rounds rapid.

The gunlayer straddled his object (with the third and fourth rounds), but his best shot was some twenty yards off being a hit, and the creature ignored the performance entirely.

The second gun's crew were now closed up, the helm was put over, and the range opened again to about 1200 yards, and the five rounds rapid repeated. This time two shots seemed to fall very close to the object, but still quite failed to disturb its equanimity.

The third gun's crew was now closed up, and on my order, "Five rounds rapid," the first shot fell very close to the creature, the second was a clean hit, and produced at once a furious commotion, which reminded me more than anything else of a bather lying on his back in smooth water and kicking out with all his force to splash the water, only of course the commotion on this occasion was on a vastly greater scale. It continued for perhaps three seconds, and then stopped, and we saw no more of the creature,

though we passed close to the spot where it was last seen, so I gave orders for the ship to be put back on her patrol course, and left the bridge, telling the navigator to make a brief notation of the whole circumstance in the log.

Just to confirm the story, it became known later that not only a vessel of the British patrol fell in with a sea serpent but that some of the German blockade-breakers did as well. One German submarine reported that while cruising submerged it caught a fleeting glimpse of such an animal. Another German submarine also had a brief view of one, but a *better* view. This was the *U-28,* the commander of which, Captain Freiherr von Forstner, told the case explicitly when the Loch Ness reports made good copy for the newspapers.

On July 30, 1915, our *U-28* torpedoed in the North Atlantic the British steamer *Iberian* (5223 tons) loaded with valuable goods. The ship, which was about 180 meters long, sank rapidly, stern first, the depth at this point being a few thousand meters. When the steamer had disappeared for about 25 seconds it exploded at a depth which we could not know, but one thousand meters will be a safe guess. Shortly afterwards pieces of wreckage, among them a huge marine animal which made violent movements, were thrown out of the water, flying approximately 20 or 30 meters high.

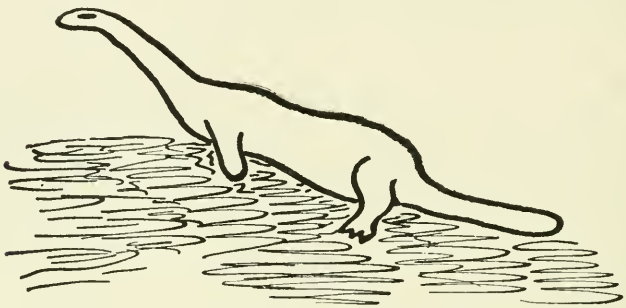
At this moment we were six men on the bridge, myself, the two officers of the watch, the chief engineer, the navigator and the helmsman. We at once centered our attention upon this marvel of the seas. Unfortunately we had not time to take a photograph because the animal disappeared in the water after 10 or 15 seconds. It was about 20 meters [66 feet] long, looked like a giant crocodile, and had four powerful paddle-like limbs and a long pointed head.

The explanation of this event seems easy to me. The explosion of, or in, the sinking steamer caught the "undersea-crocodile," as we called it, and forced it out of the water.

When his account was attacked Captain von Forstner stood firm and declared that "he would not give up a single meter of the length of his animal."

The sea serpent did not disappear after the First World War; there are at least half a dozen different reports from the period between 1919 and 1933. These, however, were not as widely publicized as those that came in 1933, the reports from Loch Ness. Only a few years before the stories from Loch Ness made newspapermen all over the world

wonder what it was all about, Lieutenant-Commander R. T. Gould had published his excellent book *The Case for the Sea-Serpent* (London, 1930). The very existence of such a carefully written work of painstakingly verified reports should have put all those interested in zoology in a receptive frame of mind; but though hardly anyone had jeered at the book, the Loch Ness reports were greeted with laughter. The opportunity to make jokes simultaneously about thrifty Scotsmen, Scotch whisky, and the sea serpent was too good to be missed. And



Arthur Grant's sketch of the Loch Ness "monster"

when finally one witness, Mr. Arthur Grant of Drumnadrochit, declared that he had seen the "monster" on the road at night in the light of his motorcycle lamps, everyone simply roared with laughter.

Mr. Grant, however, defended his story. He drew a sketch of the animal he had seen for a local newspaper. When Professor Oudemans wrote him, asking for confirmation of the newspaper accounts, Mr. Grant made another sketch, which he mailed to the professor. It looked exactly like the first, but was somewhat better drawn, which is not surprising since the first sketch was made at two o'clock in the morning in a garage. Nevertheless, most people found the story of a "sea serpent" on a country road exceedingly funny.

Actually such a statement should be no stranger than, say, a claim that a sea-elephant had been seen at some distance from the beach. These large marine mammals can and do move on land—although not

very elegantly—and if the sea serpent, especially what seems to have been a young specimen, can do the same, it is only additional proof of its mammalian nature. Parliament was urged "to do something" at the time, but nothing happened. Professor Oudemans, in a little pamphlet written in English, urged the British authorities not to be tenderhearted and to kill the animal for the sake of science. He pointed out that observers had often told how quickly the sea serpent can sink. This means, of course, that its body is heavier than water, so that a specimen that died naturally would be lost, probably the reason why a dead sea serpent has never been found. But nothing was done, and finally the "monster" disappeared; nobody can tell whether it died or found its way to the open sea.

The case of the Loch Ness "monster" has never been cleared up. Rupert T. Gould made a trip to the Loch to interview all the eyewitnesses he could find and wrote a book about these interviews. It is tedious reading, somewhat like asking fifty people to describe an elephant and then wading through all fifty descriptions. The photographs which were taken were unfortunately too poor to serve as conclusive evidence. Especially one, which *may* show the head and neck has also been explained as showing the dorsal fin of a killer whale. Since there is no detail in the picture either is possible.

It was said later that the Loch Ness monster was the wreck of a German Zeppelin that was shot down during the first World War and which fell into the Loch. While the drifting hulk of a Zeppelin, with just enough buoyancy left to show at the surface at intervals, would make a fine monster, it does not agree with the rather specific statements of some of the eyewitnesses.

Whether another German submarine ran into a "sea serpent" in the course of the Second World War is not yet known; years from now some retired submarine skipper may write his memoirs and report such a case under the heading "believe it or not but I saw it."

But there is no doubt that the Grace Line steamer S.S. *Santa Clara* ran into a "sea monster" at 11:55 A.M. on December 30, 1947, just when its officers were ready to take the noon sight. The sea was calm and blue, with bright sunshine, the place was 118 miles due east of Cape

Lookout. The ship had just crossed the Gulf Stream en route from New York to Cartagena. The master of the vessel, J. Fordan, sent a report which was distributed by the Associated Press. It reads in part:

Suddenly John Axelson (the third mate) saw a snakelike head rear out of the sea about 30 feet off the starboard bow of the vessel. His exclamation of amazement directed the attention of the two other mates to the sea monster and the three watched it unbelievingly as, in a moment's time, it came abeam of the bridge where they stood, and was then left astern.

The creature's head appeared to be about 2½ feet across, 2 feet thick and 5 feet long. The cylindrically shaped body was about 3 feet thick and the neck about 1½ feet in diameter.

As the monster came abeam of the bridge it was observed that the water around the monster, over an area of 30 or 40 feet square, was stained red. The visible part of the body was about 35 feet long.

It was assumed that the color of the water was due to the creature's blood and that the stem of the ship had cut the monster in two, but as there was no observer on the other side of the vessel there was no way of estimating what length of the body may have been left on the other side.

From the time the monster was first sighted until it disappeared in the distance astern, it was thrashing about as though in agony. The monster's skin was dark brown, slick and smooth. There were no fins, hair, or protuberances on the head, neck, or visible parts of the body.

If none of the older reports be considered trustworthy any more, the experience of the *Santa Clara* proves that there is a large unknown animal in the seas. And although we have reason to believe that this great unknown of the seas is a warm-blooded mammal and not a snake, as Norse fishermen once thought, they were right in saying that it brings bad luck. It carries with it the ill luck of lifelong ridicule for the skipper who happened to encounter it and who was honest enough to describe truthfully what he saw.

8: Rumors and Shadows

I THINK it was the physicist Pascal who once said that human knowledge behaves like a growing sphere: the more it expands, the more points of its surface touch the Unknown. But it seems as if the "unknown" outside that growing sphere is not quite evenly distributed, because at times you get a quite dismal crowding in certain quarters where the growing sphere begins to touch. One of these crowded areas from the field of zoology might be labeled "Miscellaneous reports: myths, mistakes or undiscovered." Of course, the great sea serpent belongs there, but it is only the best known of many such cases.

In spite of centuries of exploration by ship, on horseback, on foot, and even by airplane and helicopter, there are still reams of rumors about animals which are either undiscovered or otherwise unexplained. At least a full dozen of them have been described with considerable detail and, although officially undiscovered and unknown, they go like shadows through books about travel and experiences in remote corners of the earth. And while explorers, their ears ringing with incredible stories, would be willing enough to dismiss them as folklore and superstition, they can't very well do so because of occasional bits of evidence: footprints that cannot be classified or pieces of skin that do not belong to any known animal. Once an unclassifiable feather rested in the Museum of Natural History in New York for two full decades until the bird to which it belonged was finally hunted down. It was the Congo peacock, one of the subjects of the last chapter of this book. Another such case concerned an animal, a portion of which had actually been an article of commerce among the

natives. The animal so "overlooked" was nothing less than a full-grown rhinoceros.

There are two varieties of rhinoceros in and near the Sunda archipelago. One goes under the scientific name of *Didermoceras sumatranus,* a comparatively small and two-horned rhinoceros whose habitat is Sumatra and Borneo. The other and larger variety is *Rhinoceros sundaicus.* It has deep skin folds like those of the African rhinoceros, possesses only one horn, which is often small and poorly developed in the females, and lives on the East Indian mainland. A sub-species, *Rhinoceros javanensis,* is found in Java.

Since the Chinese, as has been mentioned in the story of the unicorn, value rhinoceros horn as a supposed aphrodisiac and are ready to pay high prices for it at any time, the Malay hunters of those regions do a brisk trade, or at least did as long as rhinoceros was reasonably abundant. Such native hunters occasionally spoke of a third variety of rhinoceros to which they gave the name *badak tanggiling.* This, it was believed, was only another fancy native name. One could not, after all, take everything the Malays said very seriously. They insisted, for example, that the orang-utan (the name, incidentally, means "forest man") was as intelligent as a man, even more so. They said that the orang-utan could speak but kept it a secret, knowing that if he betrayed that fact he would be forced to work. The orang-utan was obviously not just as intelligent as a man, but more intelligent by far than most men! At any rate, if people with such beliefs wished to call the ordinary rhinoceros *badak tanggiling,* and to insist that it was an entirely different animal, that was certainly of no concern to science.

One day, however, a Dr. Vageler, residing in Java, came together with a professional white hunter named G. C. Hazewinkel. Zoological gardens in various countries often communicated with Dr. Vageler when they needed new animals to replace those that had died; and so when he spoke of "new rhinoceroses" he meant new materials for zoos. But when Hazewinkel agreed with his remarks, he meant something else by "new rhinoceroses." They realized the difference in their ideas when Mr. Hazewinkel said "horn." Dr. Vageler corrected him and said "horns."

"Horn," replied Mr. Hazewinkel. "One horn."

"Horns," insisted Dr. Vageler, "two horns; we are not going to the mainland. I need Sumatran animals."

"Of course you do, I know that. And the *badak tanggiling* has *one* horn. I should know, I've shot eight of them. Here are their pictures."

The pictures convinced Dr. Vageler. There actually lived a second variety of rhinoceros on Sumatra, the males with only one horn, the females often without a horn at all. It was a large variety, ten feet long, and its teeth differed from all known varieties: they were so enormous that Dr. Vageler compared them to the incisor teeth of the hippopotamus and suggested that the new rhinoceros might have a similar diet.

Dr. Vageler made his report in 1927, and promised specimens for the zoological gardens. But they never came—and the *badak tanggiling* is again only a somewhat more substantial shadow in our zoological encyclopedias. It may, however, be rediscovered almost any day.

Now there is nothing inherently incredible in talk about undiscovered animals in places like Sumatra, New Zealand, New Guinea, Madagascar, Darkest Africa, or even the interior of South America. But it does sound strange when it is asserted from time to time that a fairly large and conspicuous animal, still unknown, exists in the very middle of Europe. Yet such a story is localized in and around a number of valleys in the Swiss and Austrian Alps.

The animal is said to be a strange-looking lizard, about two and occasionally three feet in length, with a short stubby tail and small legs and feet. Of course, it does not have a scientific name and the local name unfortunately varies from valley to valley. This lizard was first given the name *Stollwurm* about a hundred years ago by a Bavarian author, who pictured it very seriously and without much excitement in his *Hunter's Manual.* Another name for the same animal is *Tatzelwurm;* it is this name that is used most frequently and is known almost everywhere in the Alps. Translated literally, it means "worm (or snake) with paws," while *Stollwurm* might be translated "cave worm."

The strange thing about the tatzelwurm is that it never got into one of the numerous natural histories of Europe and that people living at some distance from the place where it is said to occur have never even heard of it. On the other hand, natives of the various tatzelwurm local-

ities are surprised to learn that the outside world does not know about this animal or, if it does, refuses to believe in it.

In recent years Alpine journals as well as scientific magazines have conducted searches for reports about this animal and have asked their readers to submit personal experiences that might shed some light on the question whether the animal really exists. All in all they amassed about sixty different reports. The general picture that emerges is, as I have said, that of a strange-looking lizard, two or three feet long. All observers agree that it has a short and stubby tail and practically no neck, i.e, a neck that is very short and as thick as the body. The head is also thick and blunt-nosed, the color brownish on top and lighter underneath. As for the feet, there is disagreement; all observers state that they are short and very small, but some claim that the animal has no hind feet at all.

All this would not make the majority of European zoologists so very skeptical if it were not for the fact that the peasants are filled with superstitious awe of the tatzelwurm. It is capable, they say, of making enormous jumps, six or even ten feet long. And it invariably attacks, which is something reptiles do not do unless they feel themselves menaced, though, of course, there is no telling just when a reptile feels menaced. The tatzelwurm's attack, the peasants continue, is extremely dangerous; the animal is highly venomous, so venomous, in fact, that its breath can kill. When the story has progressed to this point, the zoologist stops listening. This is no longer zoology, but folklore and superstition, and except as such it has nothing at all to do with science.

It must be noted, however, that the reports collected by several men of high reputation do not mention these obvious exaggerations. None of these serious reports claims that anyone died in an encounter with a tatzelwurm; only a few claim that the animal attacked; most of them say that it ran away.

One of the reports of an attack was published by the Austrian Privy Counselor Dr. A. von Drasenovich. A professional hunter told him that he had encountered such an animal in 1908 near Murau in Upper Styria about five thousand feet above sea level. The animal "looked like a worm with four very small paws"; it was about twenty inches long and three inches thick. The hunter, when he saw the animal, pulled his strong

hunting knife from its sheath before approaching it. When he was close, it jumped at him and he tried to stab it. The knife did not at first penetrate the tough skin, but after five or six jumps and stabs the knife "caught," and the wounded animal disappeared in a narrow slit. In spite of all his efforts the hunter did not succeed in finding it.

Another report that deserves to be retold was made by an Austrian schoolteacher in 1929. During his vacation he set out to visit a not very well-known natural cave, the entrance to which is situated in the so-called Tempelmauer.

> Well equipped, I started out on a spring morning [near the end of April 1929] and after a short climb I reached the top of the Tempelmauer. After a short rest between the cliffs I started to look for the entrance to the cave. Suddenly I saw a snake-like animal sprawled on the damp rotting foliage that covered the ground. Its skin was almost white, not covered with scales but smooth. Its head was flat and two very short feet on the fore-part of the body were visible. It did not move but kept staring at me with its remarkably large eyes. I know every one of our animals at first glance and knew that I faced the one that is unknown to science, the tatzelwurm. Excited, joyful, but at the same time somewhat fearful, I tried to grab the animal but I was too late. With the agility of a lizard the animal disappeared in a hole and all my efforts to find it were in vain. I am certain that it was not my imagination that let me see the animal but that I observed with a clear head.
>
> "My" tatzelwurm did not have large claws but short and atrophied-looking feet; his length did not exceed 40 or 45 centimeters [16-18 inches]. Most probably the tatzelwurm is a rare variety of salamander living in moist caves and coming only rarely to the light of day.

The Austrian authorities in the Nature and Forestry Departments could not help but know about the alleged existence of the tatzelwurm. But they had an explanation that satisfied them, even if it aroused the ire of those who claimed to have seen the animal. They said that all tatzelwurm accounts were mistaken; the animal was most probably a wandering otter. An otter can make long jumps, it often assumes a position in which the hind legs are invisible, and it can even hiss, as has often been claimed the tatzelwurm does. To this the observers could only reply that they knew an otter when they saw one and that what they had seen was not an otter.

Early in 1934, after the investigation conducted by various publications, the "tatzelwurm question" seemed to have attained a nice "balance of power." Late during the same year, however, something happened to disturb this equilibrium, though I am sorry to have to report that it did not bring the controversy to a conclusion. It merely stirred up interest again and resulted in a number of articles in rival magazines—one group claiming reality for the tatzelwurm, the other "explaining" it on mythological principles.

Here is what happened, as told by those who claimed reality. A Swiss photographer named Balkin asserted that he had accidentally taken a picture of a tatzelwurm. He was taking a hike near Meiringen in the Swiss Alps, and had a camera along to photograph the beautiful views. At a certain spot he saw what he at first believed to be a picturesque rotting tree trunk. He decided to take a picture of it, but when the camera clicked, the "tree trunk" suddenly displayed very active signs of life, proving to be a large lizard ready for attack. The photographer fled; later, when he developed his picture, he saw that it showed fairly clearly the head of a totally unknown animal. In appearance it might best be likened to the head of a large fish of rather evil disposition. The photographer then mailed the picture to the editor of a weekly picture-magazine in Berlin. The photograph was not only accepted for publication; the publisher felt that this was an opportunity for good publicity and sponsored a rather extensive search of several square miles around the spot where the picture had been taken. But inclement weather intervened, the search had to be postponed for weeks, and then it proved fruitless.

The episode came to nothing—but that does not prove that the animal does not exist, any more than the nonsense about poisonous breath proves that the whole story is but a legend. That trait might be an exaggeration of the simple fact that the tatzelwurm has poisonous fangs. Our American Gila monster—*Heloderma suspectum* in zoological parlance —of the Southwestern desert boasts such equipment. The Gila monster's venom has also been doubted for a long time—because "venomous lizards do not exist"—but you can find it mentioned in any modern book on American animals. When we compare the tatzelwurm and the Gila monster, many similarities become apparent. The Gila monster has just such a short tail; it has just such comparatively small legs and a thick

neck. Aside from coloration and the matter of jumping, the Gila monster is a fair image of the Austrian tatzelwurm; and an Austrian scientist, Dr. Nicolussi, felt so certain of their relationship that he proposed *Heloderma europaeum* as the scientific name for the mystery animal of his home country, provided, of course, that it could first be found.

Mention of the Gila monster brings us back to the Western Hemisphere, which is by no means free of rumors of undiscovered animals. Two of them are especially outstanding, and it is a curious fact that one is very much an American counterpart of the tatzelwurm case, while the other reads like an American version of the story of the *badak tanggiling*. Since the latter is a little better substantiated, I shall start with it first: it is the story of an accidental discovery that miscarried.

One of those beautifully clear schemes the student of zoology is taught in the first semester of his studies concerns the geographical distribution of the Primates of Linnaeus, by which is meant the monkeys and apes. Man, of course, also belongs among the Primates, but since he is universally distributed he is usually left out of the scheme. Monkeys, we are taught, do not exist in Australia, Europe (save for a small herd living stubbornly near the Rock of Gibraltar), or North America; but they do live in Asia, Africa, and South America. As for the anthropoid apes, they exist only on the large Malayan islands and in Africa; South America, although prolific in monkeys, does not possess apes.

So far, so good. But in 1929 a French geologist, M. de Loys, returned from the interior of Venezuela with a very strange and somewhat fantastic story. One day, he said, while camping on the banks of the Catatumbo River, he suddenly saw two hairy figures approaching him with every sign of bad temper. M. de Loys took his rifle and shot at one of the two, which fell under his fire. The other then turned and ran away. De Loys cautiously approached the body and saw to his utmost surprise that it was that of an ape, about a little more than five feet tall. Although not a zoologist by profession, he saw that it was not a member of the well-known ape tribes living elsewhere on the globe.

De Loys realized that, while acting in self-defense, he had made a very surprising and probably also an important discovery. This put him into an interesting predicament. His expedition was equipped to make a geological survey; and while he probably had some materials for coping

with chance finds of small animals, he was not prepared to tackle the job of preserving the body of a fairly large ape. The first thing he did was to place the dead body on a small crate of convenient size and prop a branch, stripped of its leaves, under the chin. Then he took a few photographs. Knowing that he could not preserve the entire skin, he saved the skull and wrote a description of the body before it had time to decay, which does not take long in these latitudes. The ape was exactly 157 centimeters (62 inches) tall, had no tail at all, possessed thirty-two teeth and a nose built like those of the South American monkeys, not like those of the Old World apes. The thumb was very small and placed very high near the wrist.

Unfortunately de Loys met with an accident during his return trip and lost the valuable skull; only one photograph was saved. The new animal has been named tentatively *Ameranthropoides loysi* (Loys's American Ape). Since de Loys's report was published, nothing has been heard about this new animal, which threatens to upset one of the beloved teaching schemes of zoo-geographers.

Let us now turn to North America and to the second rumor I mentioned above—in short, to the much-discussed, hotly denied, and stubbornly defended great horned serpent.

The story of a horned snake living in North American woods dates back to early pioneer days. By a "horned snake" is meant one whose tail does not taper to an end in the ordinary fashion but terminates with something resembling a cow's horn. This horn is supposed to sheathe a venomous stinger, which is the main weapon of that wondrous snake, for, instead of striking with its head, the horned snake strikes with its tail. The force of the blow is so great that the snake, if its "horn" hits the butt of a rifle, cannot pull free again. At least that is what Robert Beverly wrote in his *History of Virginia,* which was printed in London in 1722. This is, incidentally, one of the earliest horned snake stories. Karl Patterson Schmidt of the Field Museum of Natural History in Chicago, who carefully collected old horned snake reports, was able to find only one dating farther back: a letter written by John Clayton to the Royal Society in London in 1688. But Clayton claimed to have seen only a horned snake, not the horn of the reptile.

Alexander Hewatt, nearly a century after Clayton, had a better story

to tell. The venom in the stinger of the horned snake is so powerful, he reported, that a young tree could be poisoned by it and die. That was printed in 1779 and five years later the English traveler J. F. D. Smyth added a finishing touch. He told that the horned snake boasts not only an armament different from that of all other snakes but also a different type of locomotion. While going at a leisurely pace the horned snake moves by the same method as do all others, but when it is in a hurry it takes its tail in its mouth, forms a hoop, and rolls along at incredible speed.

Thus the horned snake became the hoop snake, for a while respected as one of Nature's marvels but soon becoming *persona non grata* with zoologists in general and herpetologists (snake specialists) in particular. There really is no doubt anywhere that the hoop snake is but a myth, possibly suggested originally by pictures of the Midgard Serpent of Norse mythology, whose pose is so often utilized for jewelry.

Some writers have nevertheless occasionally wondered whether the horned snake might not exist—of course without the hoop snake variation. Again and again people told of encounters with the great horned serpent, often claiming to have killed one. Herpetologists see nothing in all these stories but an example of the stubbornness of an erroneous belief; to them the horned snake is a collection of observations on a large variety of well-known snakes all brought together in one myth. They may well be right. Occasionally "young horned snakes" have been killed and brought to museums. Almost invariably they have turned out to be *Ophisaurus,* the glass snake, which is not even a snake at all. For the glass snake is a lizard, legless, it is true, but still a lizard; and like many other lizards it is able to "disconnect" its tail and leave it wriggling in the mouth or hand of an attacker. While the attacker is struggling with the suddenly independent and wildly thrashing tail the glass snake makes a quick getaway, trusting to Nature to renew the tail. Nature does, but the tail does not grow again to its original size and beauty. The new tail is short, discolored, and rigid and tapers quickly to a sharp point. If the horned snake myth did not exist, the glass snake would attract but little attention—especially since a glass snake cannot harm anything bigger and stronger than an earthworm—but because of that myth the glass snake is killed.

Another snake—this time a real one—that probably helps to keep the myth alive is *Farancia,* the red-bellied snake. *Farancia* has the habit of pressing against things—for example, a hand holding it—with the tip of its tail, a habit that *does* look suspicious, with all the horned snake stories sticking in the mind of the "victim." And the real horned snake stories speak about a large snake, six feet long or more, and *Farancia* does grow that long.

Suspicions appear to center mainly around *Pituophis,* the bull snake; and Herbert Ravenel Sass, who published an excellent article on the horned snake in the *Atlantic Monthly,* May 1935, believes that *Pituophis* may be largely responsible for the myth.

> His magnificent dimensions—he is sometimes nine feet long—compare favorably with those of the mighty horn snake of the stories. In the second place, a peculiar arrangement of his glottis enables him to hiss much more loudly than most other serpents, and this at once recalls the many storied horn snakes whose loud hissing was one of their most startling characteristics. In the third place, *Pituophis* is capable of berserker rages, and a man coming upon him suddenly might well be terrified half out of his wits by this huge, hissing, furious serpent, which looks as if it were about to annihilate him, though in reality it is only seeking a chance to escape. In the fourth place, the extreme end of the bull snake's tail is hard and horny to the touch, and, while this horny part is probably never more than an inch long even in the largest specimens, a half-inch might easily become several inches in the eye of an excited man or woman in the frenzy of "serpent panic." And in the fifth place, there is historical evidence, apparently overlooked altogether by those who have puzzled their heads about the horn-snake mystery, that the bull snake in former years actually bore the name of horn snake. "These serpents," wrote William Bartram, describing the bull snake about a century and a half ago, "are also called horn-snakes, from their tail terminating with a hard, horny spur, which they vibrate very quick when disturbed, but they never attempt to strike with it." All this, together with the fact that bull snakes vary almost as widely in color as the horned serpents of the tales, constitutes a pretty strong case against *Pituophis.* . . . Yet, even when this is done, all is not yet explained; for *Pituophis* the bull snake, having no venom in him, may frighten but cannot kill.

It is true that *Ophisaurus* the glass snake, *Farancia* the red-bellied snake, and *Pituophis* the bull snake could all help to keep an existing myth

alive; but it is hard to see how they could have given rise to the myth of the horned snake, which must have originated with a poisonous serpent. Here Mr. Sass has suggested an interesting and plausible theory. He received a letter from "a well-known clergyman" who wrote that he and some others had thought at first to face a rattlesnake and that even when it was killed they still thought so. But

> when we pulled it out of the ditch we found that it was not a rattler, but that, in place of the rattle, a continuation of the end of the tail was a sharp, flinty, polished horn or point, the hard point or horn being about an inch and a quarter long. The horn was of the hardness or more of a gamecock's spur. . . . The horn was not hollow when cut off. It had no stinger in it that we could see. The snake was the shape and the color of the rattlesnake, maybe a bit duller in color. . . .

Since the great horned serpent is often compared to a rattlesnake in size and color, Mr. Sass suggests that occasionally rattlesnakes with abnormal solid rattles might be found. Of course, these pseudo-horned snakes do not deal their fatal bites otherwise than do normal rattlers; but if the encounter proved fatal to the snake, the curious horn at the end of its tail was viewed with suspicion. Most probably this thing had been a weapon, more powerful, more poisonous even than the fangs. Thus the great horned serpent was conceived.

Still, it has not yet been discovered, either as an independent member of the snake family or as a rattlesnake with an abnormal rattle.

Skepticism, like gravity and light, diminishes with the square of the distance from the point of origin. The Austrian zoologist who scoffs at the mention of the tatzelwurm, or the American herpetologist who can just barely get himself to believe that abnormal rattlesnakes may come into being from time to time, has no trouble at all when it comes to unknown creatures in New Zealand or Australia. One of the New Zealand rumors refers to an animal called *waitoreke* by the aborigines. It is said to be a fairly large marsupial, rare and of nocturnal habits. At night it may be seen approaching a drinking place, betrayed only by the light, almost white, color of its pelt. But then it vanishes again—and so far no one has been able to tell what it is or whether it actually exists.

Again when Charles Darwin's theory of evolution had just about conquered the scientific world, word came from New Zealand that strange

tracks had been seen in freshly fallen snow. They were taken to be bird tracks, apparently of a very strange bird. Darwin himself had high hopes; possibly New Zealand had preserved a very primitive bird. In his cautious manner he stated that such a thing was "at least possible," and he urged everyone who lived on or came to New Zealand to keep an eye open for such a bird. But no further news was ever reported.

The Australian rumors are of a slightly more tangible nature. At the time when excessive moisture and a slight but general drop in temperature (only about ten degrees Fahrenheit or so) had caused gigantic glaciers to form and to creep all over Northern Europe and a good part of North America, the Australian climate was less dry than it is now. Much of the Australian desert was then covered with vegetation, and Australia's marsupials throve and evolved some colossal forms—beasts as large as cattle. Some forms, especially one called *Diprotodon,* for example, even approached the dimensions of an elephant. When Australia's interior became a desert these giants died. Only the smaller and more mobile forms were able to race the drought. These events took place only a few moments ago, as the geologist measures time, and the white man came only a split second too late to see them. If Assurbanipal had sent his men on an expedition to Australia, they might have arrived just in time to see those incredibly large marsupials still alive; or they might have been a few centuries late, but no more. At any event, the giant marsupials died out "very recently."

Of course, there have always been people who nursed the secret hope that it might not be too late even now. Maybe *Diprotodon* and the other gigantic marsupials could still be seen alive, if only one could find their last asylum. Among those who held this belief was one Dr. Ludwig Leichhardt, a German-born Australian explorer. It was his ambition to add to the already considerable zoological fame of his adopted country by discovering the giants of Australia's fauna. Somewhere in the interior they could still be found, he was convinced, and he led an expedition into Central Australia. His expedition was never heard from again; it succumbed to the same dryness that had eliminated its objective thousands of years before white men ever set foot on this "attic of the world."

Among the bones that tell of the former existence of these animals

there are none—at least not to my knowledge—that belong to an exceptionally large kangaroo. Yet it is precisely about this that rumors tell. Prospectors who ventured into the western deserts and mountains occasionally returned without gold, but with tales of a kangaroo fifteen feet tall. Nothing more definite is known about this creature—just a tale about a fifteen-foot kangaroo, flitting like a shadow through the little-known deserts of western Australia.

Another Australian rumor of an undiscovered animal comes from North Queensland. In order to understand its meaning we have to become acquainted with a few facts first which will find further elaboration in the third part of this book. Mammals, as a whole, fall into three distinct groups. The most numerous of them right now are the so-called placentals, which carry their unborn young in an internal womb. The next group are the marsupials, which put their young, which are very unripe when born, into an external pouch. The third are the monotremes, which lay eggs.

This last group is now restricted to Australia and New Guinea and numerically is very small—the platypus chapter tells their story. The marsupials would be a small group today, consisting of the American opossum and a very few others, if it were not for Australia. Even though Leichhardt was unsuccessful in his quest, the marsupials are the dominating life form of Australia; there are no *large* mammals in Australia which are not marsupials. The two major exceptions are the Australian aborigines, which immigrated at some time in the past, and the Australian wild dog or dingo, which must have immigrated too. Now, there are carnivores among the marsupials as there are among the placentals. Present-day Australia lacks a large catlike marsupial carnivore, but there is one on Tasmania, the rather rare, ferocious, and conspicuously striped *Thylacinus cynocephalus,* commonly called Tasmanian tiger.

But if that North Queensland rumor is correct, the preceding sentence must be changed to read: "Present-day Australia still has a rare and seldom seen catlike marsupial carnivore, just as Tasmania has one in its so-called Tasmanian tiger."

The story of this rumor has been outlined by the British author Frank W. Lane in his book *Nature Parade.* It seems to have made its first "official" appearance in the *Proceedings of the Zoological Society* for

1871. Mr. B. G. Sheridan, a police magistrate at Cardwell, told that his son had taken his evening stroll with his terrier when the dog suddenly took up a scent and followed it for about a mile. The encounter was brief and inconclusive and described by the boy with the following words:

> It was lying in the long grass, and was as big as a native dog. Its face was round like that of a cat. It had a long tail and its body was striped from the ribs under the belly with yellow and black. My dog flew at it, but could not throw him. The animal ran up a leaning tree. It then got savage and ran down the tree at the dog and me. I got frightened and came home.

Australian naturalists are quite willing to concede the possibility that there is a large unknown catlike mammal (probably a marsupial) hiding in the only sketchily explored forests of the York peninsula which, after all, has roughly twice the area of England. The people living there speak of it matter-of-factly, like the Australian writer Ion Idriess:

> Up here in York peninsula we have a tiger-cat that stands as high as a hefty medium-sized dog. His body is lithe and sleek and beautifully striped in black and grey. His pads are armed with lance-like claws of great tearing strength. His ears are sharp and pricked and his head is shaped like that of a tiger. My introduction to this beauty was one day when I heard a series of snarls from the long buffalo grass skirting a swamp. On peering through the grass I saw a full-grown kangaroo, backed up against a tree, the flesh of one leg torn clean from the bone. A streak of black and grey shot towards the kangaroo's throat, then seemed to twist in the air, and the kangaroo slid to earth with the entrails literally torn out. In my surprise I incautiously rustled the grass and the great cat ceased the warm feast that he had promptly started upon, stood perfectly still over his victim and for ten seconds returned me gaze for gaze. Then the skin wrinkled back from the nostrils, white fangs gleamed and a low growl issued from the throat. I went backwards and lost no time getting out of the entangling grass.—The next brute I saw was dead, and beside him was my prized staghound, also dead. . . .

Frank W. Lane found another report in the *Brisbane Courier* (unfortunately he neglected to give the date) which seems to be quite recent, telling of two men who came across such an animal at close range but in a torrential rain. Their description, however, agrees well

with those quoted—there can be little doubt that a large North Australian carnivore still awaits official discovery and detailed description.

Before proceeding to the classical continent of undiscovered animals, Africa, some marine mysteries of the Pacific Ocean might be mentioned as briefly as is consistent with stating their case. One of these stories comes from the immediate vicinity of Australia, specifically from the Timor Sea, the expanse of water between the long island of Timor to the north of Australia and the mainland. This sea, the natives claim, is inhabited by a large, ferocious man-eating shark. It is larger, they say, than the well-known man-eating shark. Of course, there are a number of sharks that grow bigger than the man-eater, but these are not man-eaters. This mysterious fish is said to differ from other sharks in one important and conspicuous point: it does not possess the typical triangular fin on its back; yet it is definitely a shark. It is said not to swim at the surface of the sea but to lie in wait on the bottom. Consequently, the natives call it the "ground-shark."

To deny the truth of this story would be to assert that every fish in the seven seas is known to science, and recent events have cautioned even the greatest skeptics (they should be called optimists, rather) not to be too dogmatic in making such statements.

A few years after the conclusion of the First World War a scientist returned from a lonely but famous island in the Pacific Ocean with a tale about an animal that had never reached the white world, not even in the form of a rumor. Professor J. Macmillan Brown had spent several years on Easter Island investigating the incompletely known history and migrations of its inhabitants. He was not, as a matter of fact, much interested in animals, but when he came across references to a creature of which he had never even heard, his curiosity was aroused. The animal's name was given as *niuhi* by the Easter Islanders, a word for which there is no known equivalent in English or any other civilized language. Professor Brown at first thought that the "*niuhi,* the only animal that inspires the Easter Islanders with terror," was some local species known to science, but soon he and the other Europeans on the island found out that it was not.

> It is not a shark; the Easter Island shark (*mongo*) does not seem to be a man killer. It is not a whale (*taoraha*); for besides the large mouth that

is one of its prominent features it has a large throat capable of swallowing a man and sharp teeth capable of lacerating him.

Questioning and cross-questioning of every Easter Islander who professed to know something about the *niuhi* finally resulted in the following description:

> The animal is about 30 feet long and is also very broad even in the head. Its arms are at least four feet long, stretching from the shoulders or below the head; when swimming these are stretched behind the neck; but when in action they are thrust forward towards the prey, which it enfolds with them and draws towards its capacious mouth; the natives call them *rape,* whilst its claws or hands they call *ƙara*. It generally swims in pairs and it has a pilot-fish which the natives call *mama niuhi*. My informant encountered one when out fishing in a boat. He had hooked a large *ƙahi,* or tunny, and as he drew it in he saw the monster following it with its arms outstretched; by the time it reached the surface and was near the boat it had swallowed the fish and still pushed on. They struck it vigorously on the head with the oars and at last it dived. Again, on the island itself he and some others saw a *niuhi* approaching; the sun was behind them and threw their shadows on the water; it snapped at the shadows and disappeared.

The veracity of a number of stories told by the natives, including one that deals with two men swallowed whole by a *niuhi* and soon afterward disgorged alive though not exactly sound, may reasonably be doubted. But the natives, at any rate, are convinced that the animal exists, although it is not very numerous in the vicinity of Easter Island. While Professor Brown was not quite able to form an opinion about whether to believe in the reality of the *niuhi,* he succeeded in finding a native picture of one, brought to civilization by the *Mohican* party.

Although this mention of what is probably an unknown sea mammal is certainly the first as far as Easter Island is concerned, I do not think that it is quite the first report on it. In June 1890 Miss S. Lovell, then a schoolteacher living at Sandy Cape, Great Sandy Island, Queensland, Australia, reported that she had seen an unknown animal which might well have been of the same kind as the Easter Island *niuhi*. Miss Lovell, in describing her animal, called it a "monster turtle fish" and wrote that it let her stand for half an hour within five feet of it.

When tired of my looking at it, it put its large neck and head into the water and swept round seaward, raising its huge dome-shaped body about five feet out of water, and put its twelve feet of fish-like tail over the dry shore. . . . It has either teeth or serrated jaw-bones. Native blacks call it *moha-moha* and say they like to eat it and that it has legs and fingers. I did not see its legs as they were in the water. What I saw of it was about 27 or 28 feet, but I think it must be 30 feet in all. Whilst its head was out

Unidentified picture from Easter Island, presumably the *niuhi*. The original is a painted stone, brought to England by the *Mohican* party

of water it kept its mouth open . . . the jaws are about 18 inches in length. The body was dome-shaped, about eight feet across and five feet high, smooth and slate-gray in color. Tail about 12 feet, the fish-part wedge-shaped and fin of chocolate-brown.

It might be added here that the Easter Islanders told Professor Brown that they had caught young *niuhis* which had a dark-blue smooth skin. When Miss Lovell's report was doubted, she could not only furnish the testimony of five other white people who had seen the animal in the same locality within a week's time of her own observation, but she also began to question the natives. She wrote:

The blacks who had not seen it on the day I did named it at once from my sketch and called it *moha-moha* and laughed and said, "Saucy fellow,

Meebee." . . . It is eight years since it attacked the blacks' camp. It can stand upright and it put its legs on the shoulders of a powerful black, six feet high, and knocked him down. That year it invaded their camp, and nearly caught one man by the leg. For months after the blacks camped inland.

Although people in Queensland have been on the lookout for the *moha-moha* since that time, no additional report has ever come in. But that absence of additional evidence is not quite sufficient reason for doubting the word of a number of obviously sincere and intelligent white people who could gain nothing from such a story. And it is hard to be mistaken about the appearance and dimensions of an animal that has been viewed in bright sunshine at a distance of five feet for half an hour.

Whether the *moha-moha* is an unknown kind of large marine turtle or a somewhat strangely shaped marine mammal is, of course, impossible to say. But it seems to me a fairly reasonable hypothesis that the *moha-moha* of Queensland and the *niuhi* of Easter Island (which seems to be known under a similar name in the Marquesas Archipelago also) are the same. One day the animal may become definitely known, and be hailed as a great discovery and a "complete surprise to science." [1]

And now we come to the greatest rumor-breeding territory of all: Africa. This gigantic continent, the continent of endless deserts and even more endless tropical forests, of enormous rivers and horizon-spanning lakes, is literally alive with stories of undiscovered animals, animals ranging in size from tiny mice to a kind of river dolphin or river whale said to inhabit certain streams of the West Coast. The suspicions range in variety from unknown apes to (literally) still living dinosaurs. Of course not all of these rumors must necessarily be true, but some of them were, as has been shown by the discovery of the okapi and others. When the okapi burst as a surprise on the scien-

[1] Evidence of a large and unknown animal, possibly a gigantic turtle, has turned up in Florida during the winter 1947–8. "Something" had tried to climb the sea wall, without success. The tracks looked like turtle tracks but were much too large and too far apart for anything known.

tific world just after the turn of the century, big-game hunters, zoologists, and animal dealers began to turn an attentive ear to other rumors . . . they might be true, after all.

In particular the files of Carl Hagenbeck, animal dealer at Stellingen near Hamburg in Germany, were combed. Dubious reports of tales told by natives were often brought back from Africa by Hagenbeck's collectors. There were articles in the files about animals that could not be classified, catalogues of animals that were described as living in Africa but that did not appear in delivery bills of the animal trade.

Interest began to center upon Liberia, situated on the Atlantic coast of the Dark Continent. Specifically, it pointed to the possible existence of an animal known only by report under the native name of *nigbve*. Slowly the history of this *nigbve* began to take form. First was found a description of the animals of the "Pepper Coast" (Liberia) written by the Dutch Dr. Dapper in 1688. In this description three varieties of wild hogs were mentioned. Two of them were comparatively abundant and well-known; the third, described as much larger than the others, black, and very dangerous because of its sharp teeth, presented a puzzle. Then someone guessed that this third "wild hog" might be the same animal described in 1844 by an American physician, Dr. Samuel G. Morton.

Dr. Morton had acquired a single skull, which, he had been told, belonged to an animal that looked like a large pig. Morton saw at once that it was by no means a pig, but an animal related to the hippopotamus. The relationship did not seem to be very close, so Morton invented a special generic name: *Choeropsis*. The common name unfortunately became pygmy hippo, which makes it seem as if the *nigbve* of the Negroes were only a dwarf form—"only" six feet long—of the common hippopotamus. Actually the two are not "brothers" but only distant cousins, as Dr. Morton had deduced from the skull.

In the eighties complete specimens of the animal—killed by native hunters—were seen by the Dutchman Büttikofer and the German Schweizer. Büttikofer did not see the animal alive and for that reason the skins were mounted very faultily in several museums. For some

unknown reason one curator later pasted a label bearing a skull beside the name of the animal. To the visitor this meant that the animal was extinct.

It was evident to experts, however, that the "pygmy hippo" was actually Dapper's "third hog." It was larger than the other two, it was black, and it had a set of very real teeth that seemed to justify even the most exaggerated description of its powers.

Toward the end of 1910 Carl Hagenbeck felt sufficiently certain that the misnamed pygmy hippos were still alive somewhere in the interior of Liberia to assign the best man of his staff of animal collectors, Hans Schomburgk, to find them and to bring them back alive. This was by no means an easy assignment, and Schomburgk at first experienced the fate of all men who try to do something no one else has done before: he was laughed at. All the possible variations were rung on the famous phrase "There ain't no such animal." The Negro officials told him that the animal was extinct, if indeed it had ever lived in the land. The white employees of shipping agencies patronizingly suggested that he go elephant hunting instead; it was safer, and more likely to bring results. A friendly fat Dutchman advised that he stay with him for a few months and then return with the report (which would be true) that the animal did not exist. All in vain; Hans Schomburgk continued with his expedition. It was in the middle of the rainy season, but Schomburgk had disliked the thought of waiting in Hamburg for the rains to cease; besides, since nothing was known of the habits of this "extinct" animal, it was a toss-up which would be the best season to hunt it.

Schomburgk's first discovery during this trip concerned the real hippopotamus. It existed in Liberia, despite all the assertions to the contrary in the books. He remembered that a French nobleman had asserted the existence of hippos in Liberian waters as early as 1724, but this had been forgotten along with many other things.

Finally Schomburgk arrived in a district where *nigbve* was not regarded as a superstition. The natives knew it well and delivered a warning speech about it. "Him be big past pig, but him be pig and love water, but him be saucy too much, we all fear him for true. Him teeth be like knife, he fit to bite man in two one time." He told them

that he wanted some and they nodded: some still remembered Massa Coffelin (Büttikofer—names change curiously in the spoken tradition of another language), he had wanted *nigbve* too. "Yes," explained Schomburgk, "but Massa Coffelin got them dead, I want them alive."

This innocent remark resulted in a parade of the entire tribe, from the oldest man to newborn babes, to Schomburgk's tent. They all looked at him in a most scrutinizing manner. Schomburgk stood it patiently for a while; then he asked the reason for this remarkable procession. He was politely informed that the brave hunters believed him crazy; there was no other explanation for his desire to catch a dangerous *nigbve* alive. And since no one in the village had ever seen a crazy white man, they had all come to have a look.

Schomburgk finally acquired all the help he wanted. And on June 13, 1911, he—the first white man to do so—saw a pygmy hippo alive in its natural surroundings. He was about twenty feet from it, but saw no possibility of catching it. He could easily have shot it, but did not dare to. This animal had been regarded as extinct for more than a quarter of a century; it must be very rare; it might even be a Last Mohican. To shoot might do irreparable zoological damage. He had to let it pass.

That was the end of the *nigbve* hunt for that year. The rainy season set in anew, the rivers became dangerous, it was too late. Schomburgk returned to Monrovia, the capital of Liberia, and told about actually seeing a live dwarf hippo. No one believed him; one does not see a mythical, or even an extinct, animal roaming around alive. Fortunately, Schomburgk had had plenty of opportunity to develop armor against such non-belief. Calmly and empty-handed, but with definite knowledge, he returned to Hamburg and to Hagenbeck. On Christmas Eve, 1912, he sailed for Liberia on his second expedition to track down *Choeropsis*. This time he was successful.

On February 28, 1913, he shot his first pygmy hippo. It was skinned to be mounted in a German museum (it is now at Frankfort on the Main); but first Schomburgk took careful measurements. The animal measured 172 centimeters (about 5 feet 8½ inches) from the tip of its snout to the tip of its tail; but measured around, just in front of the hind legs, the figure read 173 centimeters!

Schomburgk found that *Choeropsis* was much less adapted to life in the water than its big cousin. He also found that it had a remarkable set of teeth which made the frightened stories of the natives sound fairly credible. But when he caught his first live *Choeropsis* the following day, he had an opportunity to learn that it was more intelligent and more tractable than the large variety known since antiquity. He reported to Hagenbeck: "Pygmy hippo caught, is a nice little animal."

Having verified a rumor himself, Schomburgk naturally listened carefully to further rumors. Sometimes they were brought to him with evidence accompanying the story. A settler living near Lefini at the Congo River showed him a piece of skin which had evidently belonged to a rather large mammal. It looked very much like an elephant's skin, but it was thickly covered with reddish-brown hair. The settler described the animal as being similar in appearance to an elephant and said that the native name might even be translated as "river elephant." He was the only one who had proof for the story, but he was only one of many who had heard about the river elephant.

Another story concerned a pygmy variety of rhinoceros which was said to live in the mountainous sections of Eastern Liberia. This Schomburgk refused to believe at first, thinking it a confusion of another African animal which had just made the transition from rumor to substantiated fact. In 1890 Sir Henry Stanley had reported two widespread African rumors. One concerned a "zebra" which was supposed to live in the Rainy Forest against all proper horse habits. It turned out to be the okapi. The other was a rather extravagantly described "black hog" in the Ituri Forest. Its actual discovery came in 1904 when Captain Meinertzhagen of the British East African Rifles secured a somewhat imperfect skin of the animal and a perfect skull with some skin attached from another individual. The pieces were examined in the British Museum and were labeled *Hylochoerus meinertzhageni.* It actually was an enormous black hog, the largest wild pig of Africa, now known to exist in four varieties all through the equatorial belt of the African continent. It is large and jet black, and has a head which is exceptionally large even for a wild hog. Its tusks

are very massive and quite long and it is an interesting link between the two groups of the wart-hogs and the bush-pigs.

Schomburgk was convinced that his informants spoke of the East Liberian variety of Meinertzhagen's wild hog when they told about the pygmy rhinoceros. But after a while he grew unsure of this pat explanation, because intelligent questioning proved that the natives distinguished sharply between the two animals. They insisted that their "small mountain rhinoceros" was not the same, and Schomburgk, at least, did not doubt their word, especially since both stories were strictly localized—those about the small rhinoceros to the mountains of Eastern Liberia, those about the river elephant to the region around Lake Leopold.

That there exists a special race of mountain lion in the Kenya country seems rather well established. It is smaller than the true lion, but might be closely related to it. In any zoology book you can find the statement that lion cubs do not show the uniform color which is so typical of the adults, but are born spotted. These spots fade quickly, although some individuals retain them for a longer period of time. The Kenya mountain lion is not only said to be smaller than the true lion, but it is also stated to retain the cub spots all through his life. Fact is that a Warden of the Kenya Colony, a Captain Dent, saw four such lions at an elevation of about eleven thousand feet, while somebody else shot two others, skinned them, and brought the skins to Kenya Game Department. Unfortunately, the skins are not enough: it is, for example, impossible to judge whether they belonged to full-grown animals or not. The matter will have to rest until somebody furnishes more than the skin, especially the skull. But skepticism about the existence of this small mountain race is relatively mild, it is just something still to be proved more conclusively.

Then there are rumors about strange anthropoids. One is a large ape which is said to live in the Rainy Forest, the pygmy tribes call it the *muhalu*. Commander Attilio Gatti, the well-known African explorer, has repeatedly declared that he, for one, believes in the existence of the *muhalu* and accepts the descriptions of the pygmies who

say that it is exceptionally large, walks erect habitually, and is covered with very dark, possibly black, fur, except for the face, where the hairs are white. Even stranger than the *muhalu* are the *agogwe,* or "little furred people." The main witness is one Captain W. Hichens, who published a long article on undiscovered animals in *Chambers's Journal* (November 1927).

> Some years ago I was sent on an official lion hunt to the area (of the Ussute and Simbiti Forests on the western side of the Wembare plains) and, while waiting in a forest glade for a man-eater, I saw two small, brown, furry creatures come from the dense forest on one side of the glade and disappear into the thickets on the other. They were like little men, about four feet high, walking upright, but clad in russet hair. The native hunter with me gaped in mingled fear and amazement. They were, he said, agogwe, the little furry men whom one does not see once in a lifetime. I made desperate efforts to find them, but without avail in that wellnigh impenetrable forest. They may have been monkeys, but, if so, they were no ordinary monkeys, nor baboons, nor Colobus, nor Sykes, nor any other kind found in Tanganyika. What were they?

If Captain Hichens' experience were unique, one might pass it off as hallucination, caused by intense waiting for the lion. But there are several other such reports available, all from East Africa, all saying that they were furry, four feet tall, but looked generally like people. And, perhaps significant, that monkeys near them were not disturbed by their presence.

Schomburgk was also told about an animal called *too* by his informants, who stated that it was as large as a goat, with teeth like a dog, a deep black fur and a "mean temper." This might conceivably be the same animal that also goes under the names of *nunda* or *mngwa* or (existence and identity taken for granted) *chimiset* or Nandi bear. The English author Frank W. Lane, who has been mentioned before, has embarked on an extensive literary Nandi bear hunt, in the course of which he seems to have read his way through most of the existing books on Africa, augmented by correspondence with various African officials, game wardens, etc. The following is based on Lane's book *Nature Parade* and on the sources mentioned there which I consulted in the meantime.

To begin with, the belief in the *nunda* (I use this form because it

is easier to pronounce; actually *mngwa* is more correct, it being contracted from *mu-ngwa,* meaning "strange beast") is old. Captain Hichens pointed out that there is a song which is attributed to the Swahili hero Liongo Fumo wa Ba-Uriy, who lived around 1150 A.D. In this warrior's song there occur the lines:

Sikae muyini hewa kitu duni
Nangia mwituni haliwa na mngwa!

I dwell not in the city to become a worthless idler
I plunge me in the forest to be eaten by the mngwa!

Captain Hichens continued with some bitterness: "Thus for 700 years belief in the *mngwa* or *nunda* has persisted. I found it believed in as recently as 1922 and in more than one place. It is difficult to suppose that people have been believing in the actual depredations of purely mythical animals for seven centuries or that they have been mistaking hyenas for *mngwas* and "bears" for 700 years. . . . I am myself convinced that no normal African mistakes a hyena for anything but a hyena, a lion for a lion, or a leopard for a leopard; if he avers that a beast is other than a familiar beast to him, I am content to believe that it is not a familiar beast to me."

This is from a letter which Captain Hichens wrote to Mr. Lane. In the article in *Chambers's Journal* he quoted actual cases:

It was the custom for native traders to leave their belongings in the village market every night, ready for the morning's trade; and to prevent theft and also to stop stray natives sleeping in the market place, an askari or native constable took turns with two others to guard the market on a four-hour watch.

Going to relieve the midnight watch, an oncoming native constable one night found his comrade missing. After a search he discovered him, terribly mutilated, underneath a stall. The man ran to his European officer, who went with me at once to the market. We found it obvious that the askari had been attacked and killed by some animal—a lion, it seemed.

In the victim's hand was clenched a matted mass of grayish hair, such as would come out of a lion's mane were it grasped and torn in a violent fight. But in many years no lion had been known to come into town.

We were puzzling the problem at the *boma* next morning when the old Arab *Liwali* or native governor of the district hurried into our office with two scared looking men at his heels. Out late the previous night, they said,

they had slunk by the market place lest the askari should see them and think them evil-doers; and as they crept by they were horrified to see a gigantic brindled cat, the great mysterious nunda which is feared in every village on the coast, leap from the shadows of the market and bear the policeman to the ground.

The Liwali, a venerable and educated man, assured us that within his memory the nunda had visited the village several times. It was an animal, not a lion or a leopard, but a huge cat as big as a donkey and marked like a tabby. . . .

That night we kept watch with two armed askaris on the market; nothing happened. On parade next day we read the native constables a lecture on the stupidity of superstitions. It seemed that we were slightly premature. That night another constable was torn to pieces, and clutched in his hands and scattered about the buckles of his uniform was more of that gray matted fur.

Another indirect encounter of the same author was described by him in *Discovery* (December 1937).

Not long ago a man was brought to me at Mchinga (a small Tanganyika coastal village) on a litter and terribly mauled by some great beast. He said it was a mngwa, and as he himself was a brave and skillful native hunter who had often tracked down lions, leopards and other "killers" with me and other white men, why should we suppose that in this case he mistook a lion or a leopard for some other beast?

Whether the *chimiset* or Nandi bear is the same animal as the *nunda* will be decided only by actual discovery. Many authors seem to think so, but I have the feeling that they just find it easier to believe in one unknown man-killer than in two. The *nunda* seems to be a cat of generally grayish fur, the *chimiset,* as its English name indicates, seems to look more bearlike. Sometimes it is described as hyenalike, at any event not as catlike. And its fur is black.

In the *Annual Report for 1935 of the Game Department of the Colony and Protectorate of Kenya* one can find some "Nandi bear" stories, collected by the game warden, Capt. A. T. A. Ritchie. One of the reporters, a Mr. Anderssen, told that he was startled on a rainy day by the yelling of the natives. He went out to see what was going on and found them, a few hundred yards from the house, assembled around a killed pig. "At the same time I heard a roar from the forest, not like anything I had heard before." Anderssen wanted to track the

roaring animal, but his men refused to go after the "devil." In order to calm them down he started questioning them and received the answers: "Very big with long black hair and a long tail." Another one said: "With long black hair, the tail carried like a dog's, the head not very big but *baya sana.*" That it was a powerful animal was proved by the appearance of the dead pig.

As regards black hair, we found long black hair lost in the battle; this was not from the pig which had coarser hair. The boys could not explain in what way the head was *baya sana* but they all agreed that it was very bad.

I could not get a clear footmark in the grass. What I could see looked very large, something like the mark of an old leopard which could not draw in its claws properly. The pig appeared to have been killed in an extraordinary way, as if it had been hit with, say, a log, breaking the backbone; it had then been turned over and the stomach torn open with powerful claws. The stomach, heart, etc. had been eaten.

The emphasis on the black hair is, of course, reminiscent of Schomburgk's *too,* also the "mean temper" in one case, the "very bad" head in the other.

According to Frank W. Lane there is one case on record which may have been the killing of a "Nandi bear," accidentally accomplished, by a white man.

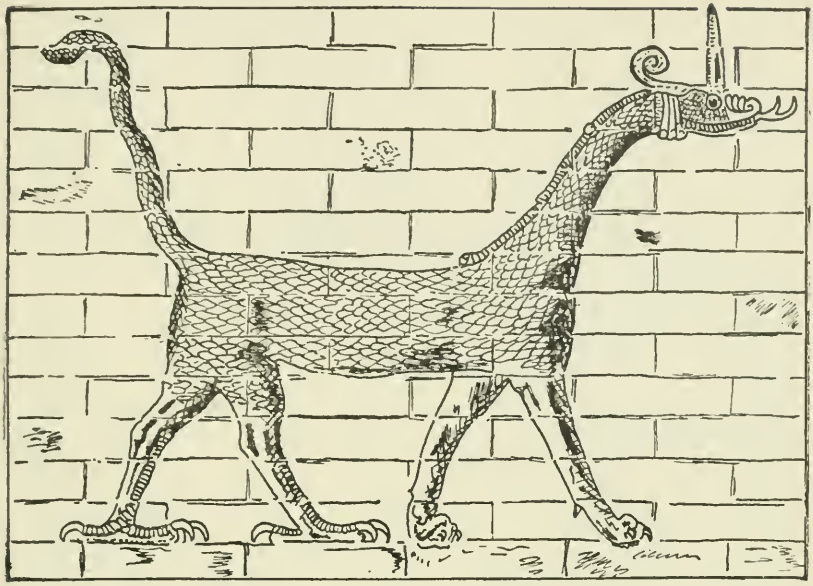
This man lived in Uganda and he once set a poisoned trap for hyenas. When he visited the trap he found a strange animal, much larger than the ordinary spotted hyena, lying dead near the poisoned meat. The head resembled a bear and the skin was yellowish brown. An old witch doctor who was consulted declared that the animal was not a hyena, but he did not know the name of it. A photograph was taken but this was subsequently lost. Fame still awaits the man who first brings in a chimiset, dead or alive.

9: *The Dragon of the Ishtar Gate*

WHEN on June 3, 1887, the German professor Robert Koldewey, on a hurried two-day visit to the site of ancient Babylon, picked up a fragment of old brick, one surface of which was covered with a bright blue glaze, he probably expected to make an archeological discovery; but he did not dream how big a discovery this would turn out to be. And he certainly did not imagine that it would pose a zoological puzzle which is still as provocative today as it was a half-century ago.

In any case Professor Koldewey did not return to this site for more than ten years. This time his plans were more definite and he spent the last three days of the year 1897 looking for more bits of old glazed brick. For the administrators of the Royal Museum in Berlin and of the German Orient Society had let fall the hint that they had funds available for excavations in Babylon, provided that interesting results could be expected. The evidence Koldewey collected on his second trip proved sufficiently conclusive to convince even these stay-at-home gentlemen who liked to make decisions about things they had not seen for themselves but who were, nevertheless, empowered to write checks of large denominations.

Everything turned out as neatly as it does in novels. "Excavations were commenced on March 26, 1899, on the east side of the Kasr to the north of the Ishtar Gate," Professor Koldewey wrote later. Then, in 1902, after a burial of many centuries, the famous Ishtar Gate itself



Nebuchadnezzar's *sirrush*

(From a photograph of the reconstructed Ishtar Gate)

emerged once more into the sunlight. Although partly ruined, it proved to be a most impressive sight. The Ishtar Gate is an enormous semicircular arch flanked by gigantic walls and opening toward a procession way of considerable length, which is also flanked right and left by walls. The building material is brick, glazed a bright blue, yellow, white, and black. To increase the splendor, the walls of the gate and the procession way are covered with bas-reliefs of unusual beauty, showing animals in very lifelike positions. Rows of gravely walking lions grace the walls of the procession way. The walls of the gate are covered from top to bottom with alternating rows of two other animals, one of them a strong and fierce bull, the other—but here is where the zoological puzzle begins.

That other animal is commonly referred to as the Dragon of Babylon and it is the same "animal" that is mentioned by that name in the Bible. The Babylonian name for it has been preserved in cuneiform inscriptions, but there is some slight doubt as to the correct pronuncia-

tion. At first the sign (it denotes the plural of the word) was read *sîr-ruššû;* the name would, therefore be *sirrush.* But Delitzsch began reading it *muš-ruššû* and translated it *Prachtschlange,* a translation which some experts say is rather loose. This, of course, provides a good excuse for retranslating just as loosely into English, giving us "Splendor Serpent" or "Glamour Snake"; but until that term is more widely accepted, it will be just as well to continue using *mushrush* or *sirrush.*

To give an impression of the size of the whole brick structure I shall quote from Koldewey's description:

> The rows are repeated one above the other; dragons and bulls are never mixed in the same horizontal row, but a line of bulls is followed by one of *sirrush.* Each single representation of an animal occupies a height of 13 brick courses, and between them are 11 plain courses, so that the distance from the foot of one to the foot of the next is 24 courses. These 24 courses together measure almost exactly two meters (6 feet 8 inches) or four Babylonian ells in height.

Originally there were thirteen rows of animals, beginning with a top row of *sirrush;* each of the eight lower rows contained at least forty animals and each of the five upper rows at least fifty-one, so that the grand total of animal pictures on the gate amounts to about 575.

It is certainly an impressive structure, and it is not at all surprising that King Nebuchadnezzar, who was responsible for the reconstruction of the Ishtar Gate, was very proud of it. When it was finished he composed an inscription which was written down in cuneiform characters for all to read. With the then customary lack of modesty it began:

> Nabû-ku-dúr-ri-u-ṣu-úr [Nebuchadnezzar], the King of Babylon, the pious Prince, ruling by the will and grace of Marduk [the supreme god of the Babylonians], supreme ruler of the City, beloved by Nebo [son of Marduk, supreme god of the neighboring city of Borsippa], of clever cunning, who never tires . . . and ever works for the welfare of Babylon, the wise one, first-born son of Nabopolassar, King of Babylon, this is I.

The inscription then goes on to tell that owing to a repeated heightening of the road to Babylon the clearance of the gates had steadily diminished so that Nebuchadnezzar finally ordered a complete reconstruction. All this is in perfect keeping with the archeological findings, so that there is no reason to doubt either the veracity or the genuine-

Sirrush, redrawn in modern style from the Ishtar Gate bas-relief, assuming the "headdress" to have been fleshy appendages

(Drawing by Olga Ley)

ness of the inscription, which is, incidentally, not quite complete. The inscription does not neglect to mention the pictures of the animals and this part reads as follows:

> Fierce bulls [the original says *rimi* or reems] and grim dragons I put onto the gateyard [meaning the gateyard's walls] and thus supplied the gates with such overflowing rich splendor that all humanity may view it with wonderment.

Humanity did view it with wonderment for centuries—and now does so again, after excavation and reconstruction—and the pictures of the *rimi* were even copied elsewhere, as the story of the unicorn has already shown us. In ancient Greece, too, the Ishtar Gate was well known by name and reputation, but the name used was the "Gate of Semiramis."

Of course no one of those who saw the Ishtar Gate in those days was plagued by zoological scruples. The lions on the walls of the procession way were lions, the bulls on the gate were bulls—even if they did look slightly different; and that King Nebuchadnezzar's artisans

had seen fit to add a monster of their own invention did not trouble anyone. They had also occasionally pictured eagles with the heads of bearded men and other hybrid monsters. In short, the pictures of the *sirrush* or *mushrush* failed to cause astonishment. It required the tremendously enlarged knowledge of the later age that excavated and reconstructed the Ishtar Gate to feel astonishment about those pictures.

The bas-reliefs of *sirrush* are very definite in outline and show a slender body covered with scales, a long slender scaly tail, and a long slim scaly neck bearing a serpent's head. Although the mouth is closed, a long forked tongue protrudes. There are flaps of skin attached to the back of the head, which is adorned (and armed) with a straight horn, possibly a pair of horns, since the pictures of the *rimi* also show only one horn. "It is remarkable," wrote Koldewey, "that, in spite of the scales, the animal possesses hair. Three corkscrew ringlets fall over the head near the ears; and on the neck, where a lizard's comb would be, is a long row of curls."

Most remarkable, however, are the feet. The fore-feet are those of a catlike animal, say a panther, but the hind feet are those of a bird. They are very large and four-toed, covered with strong scales. And in spite of the combination of so many different characteristics the *mushrush* looks tremendously alive, at least as much as the urus shown next to it, if not more so.

If the Ishtar Gate had been excavated a century earlier, this combination of catlike fore-feet and birdlike hind feet would have been sufficient proof that the "Glamour Snake" was no whit more credible than the winged bulls and man-headed birds of Assyrian and Babylonian mythology. During these hundred years, however, Georges Cuvier had become the "Father of Paleontology," Professor O. C. Marsh in America had earned the title of "Father of Dinosaurs," and our conceptions of what was biologically possible had changed greatly. Paleontologists had discovered fossil animals that sported endless necks and endless tails, big bodies and small heads, serpent heads with horns on them—and possibly even forked tongues (although unfortunately tongues do not fossilize)—and similar attributes. They had even found a special group of dinosaurs, the ornithischians, or "bird-footed ones," that walked upright on their birdlike hind legs, waving smaller five-

toed fore-legs in the air. They had even found some that seemingly had been undecided whether to walk erect or not and that probably used both types of locomotion alternatingly, according to fancy or to circumstances. A living and fairly large lizard from Australia had come to light *(Chlamydosaurus),* which walked on all fours under normal conditions and on its hindlegs only when in a hurry.

Consequently, *mushrush* suddenly began to look very real and quite possible. It was thought at first that it might be a picture of a saurian. Professor Koldewey, who had given more thought than anyone else to the identity of *sirrush* (he preferred this term), wrote in 1913 that the Babylonian dragon corresponds in most features to extinct saurians. "The *sirrush* . . . far exceeds all other fantastic creatures in the uniformity of its physiological conceptions," he stated, and then concluded with a sigh: "If only the forelegs were not so emphatically and characteristically feline, such an animal might actually have existed." Knowing that the Bible explicitly asserts the existence of *sirrush,* he ventured the guess that the priests of Babylon kept some reptile and exhibited it in the semi-darkness of a temple chamber as a living *sirrush.* "In this case there would be small cause for wonder that the creature did not survive the concoction of hair and bitumen administered to it by Daniel." [1]

This is from Koldewey's first comprehensive report about his Babylonian excavations. In 1918—five years later—he wrote a beautifully illustrated folio tome on the Ishtar Gate and had to wage another struggle with the dragon. This time he grew bolder. Although still somewhat bothered by the very catlike formation of the fore-legs, he cited lists of extinct saurians showing one or another feature of the *sirrush* and concluded that the animal, if it did exist, would have to be classified as a bird-footed dinosaur. After approaching his conclusions cautiously he suddenly states: "The Iguanodon of the Cretaceous layers of Belgium is the closest relative of the Dragon of Babylon."

This development in the attitude of a top-ranking expert is interesting and significant. He started out by finding something he was not looking for—especially since it was not even in his field of knowl-

[1] In the Bible Daniel is said to have killed the animal by giving it a pill made of bitumen and hair.

edge—and when he realized what it was he had found, he had many entirely justified doubts. But the uncanny biological credibility of the ancient bas-relief compelled him to dismiss those doubts one by one until he had to state that the picture showed an animal closely resembling a known fossil saurian.

The story is surprising in more than one respect. The Ishtar Gate was enlarged and adorned with those bas-reliefs by order of a king who is known mainly because he is repeatedly mentioned in the Bible. And the two most mysterious Biblical animals appear side by side—rather, one on top of the other—on that gate: the reem which should not be trusted even though his strength is great, and the dragon that was kept in a temple in Babylon and worshiped by the inhabitants of that city until it was killed by Daniel.

Of the two, the reem was finally identified as the urus. How about the *sirrush?* It definitely is not simply an invention. Koldewey himself said that this seemed unlikely if only for the reason that the picture of the *sirrush* remained unchanged for thousands of years, a fact which does not apply to the other fantastic creations of the Babylonians. The *sirrush* appeared in recognizable form in the earliest Babylonian art and was still pictured under the reign of Nebuchadnezzar, about 604–561 B.C.

Modern science has little trouble in identifying the type of saurian to which *sirrush* belonged, despite the facts that fossil remains of the exact variety are not known and that the artist seems to have made some minor mistakes. Such errors, incidentally, apply to the picture of reem too, and the accepted explanation is that the original reem, the urus, had been extinct in the vicinity of Babylon for at least two centuries when the bas-reliefs were made. Now, it is certain that the Babylonians knew nothing of paleontology. Their *sirrush* is either a direct portrayal of something they knew or a miracle of correct imagination, but it is certainly not a "reconstruction." Besides, there is no known site of fossil dinosaur bones anywhere near Babylon.

Since we do not know of a living or recently extinct animal that could have served as the model for the *sirrush,* we have the choice of either giving up at this point or of proceeding under the assumption that the *sirrush* actually *is* a direct portrayal of an animal unknown to

present-day zoology. We do not need to be troubled by the fact that it is a highly unlikely animal for the vicinity of even ancient Babylon. The reem, pictured next to the *sirrush,* was also extinct in Mesopotamia at that time, but lived on in Europe for two millennia more. To the Babylonians he was a "monster from afar" and the same probably applied to the *sirrush.*

But from where?

There would be no answer to that if it were not for the fact that travelers and explorers have picked up some "glazed bricks" in the only area where a monster like the *mushrush* or *sirrush* could still exist without being easily detected—in Central Africa. One of these "glazed bricks" was discovered quite accidentally by the big-game hunter Hans Schomburgk, years before Koldewey published his first comprehensive book.[1]

When Schomburgk returned to Germany after his successful quest for the pygmy hippo in Liberia he brought back with him an astonishing tale. He was all the more surprised when the dealer Carl Hagenbeck, his employer, did not laugh at him, but remarked that he had repeatedly received very similar reports. The natives, these reports had stated, spoke of a large animal, "half dragon, half elephant," that was supposed to live in inaccessible swamps. They could not tell much more about it, because, as Schomburgk once remarked in a lecture, "the natives, wishing to please the white visitor and hoping for a valuable gift at the same time, are only too ready to assert that they know of an animal in their territory with blue skin, six legs, one eye, and four tusks. The size is entirely up to the questioner, the native will tell him what he thinks the white man wants to hear."

Such an exaggerated desire to oblige makes experienced hunters careful. In this case, however, even without specific questioning, the informants usually mentioned that the animal had a single horn.

Schomburgk apparently had never heard of this animal when he went to Liberia. But when he arrived on the shores of Lake Bangweolo, an environment that seemed ideally suited for hippos, and asked why

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[1] It is one of those little ironies of fate that somebody who used this chapter extensively without mentioning the source took this sentence literally and even "improved" it by saying "bricks of precisely the type made by the Babylonians."

there were none, the natives answered matter-of-factly that there was a good reason. They—I am quoting now from Schomburgk's book *Wild und Wilde im Herzen Afrikas*—

reported that there is an animal living in this lake, which, though smaller than a hippo, kills them and feeds on them. It must be fully amphibian in its habits, it never comes to the shore and its footprints were never found. Unfortunately I thought this story to be a fairy tale and did not investigate further. Later I spoke to Carl Hagenbeck about it and I am now convinced that it must be a saurian of some type. I am of this opinion because Hagenbeck received reports from other sources that fully agree with my own observations and with the reports of the natives questioned by me. Hagenbeck sent a special expedition to Lake Bangweolo; unfortunately this expedition did not even find the lake.

In 1913, the German government sent an expedition under the leadership of Freiherr von Stein zu Lausnitz to make a general survey of its colony in the Cameroons. The official report of this expedition, which is still in manuscript, contains a fairly extensive section dealing with Schomburgk's unknown animal. It is only natural that Captain von Stein worded his report with the utmost caution, referring guardedly to a "very mysterious thing," which "possibly does not exist except in the imagination of the natives," but which is "probably based on something more tangible." Captain von Stein's evidence consisted, as he expressed it, of "narratives of natives of the former German colony" (Cameroons) about a "creature feared very much by the Negroes of certain parts of the territory of the Congo, the lower Ubangi, the Sanga, and the Ikelemba rivers." He stressed the fact that the narratives came from "experienced guides who repeated characteristic features of the story without knowing each other." The natives named the creature *Mokéle-mbêmbe,* but whether the name had any special meaning was uncertain. Captain von Stein wrote:

The creature is reported not to live in the smaller rivers like the two Likualas, and in the rivers mentioned only a few individuals are said to exist. At the time of our expedition a specimen was reported from the non-navigable part of the Sanga River, somewhere between the two rivers Mbaio and Pikunda; unfortunately in a part of the river that could not be explored due to the brusque end of our expedition.[1] We also heard about

[1] This refers to the outbreak of the First World War.

the alleged animal at the Ssômbo River. The narratives of the natives result in a general description that runs as follows:

The animal is said to be of a brownish-gray color with a smooth skin, its size approximately that of an elephant; at least that of a hippopotamus. It is said to have a long and very flexible neck and only one tooth but a very long one; *some say it is a horn.* A few spoke about a long muscular tail like that of an alligator. Canoes coming near it are said to be doomed; the animal is said to attack the vessels at once and to kill the crews but without eating the bodies. The creature is said to live in the caves that have been washed out by the river in the clay of its shores at sharp bends. It is said to climb the shore even at daytime in search of food; its diet is said to be entirely vegetable. This feature disagrees with a possible explanation as a myth. The preferred plant was shown to me, it is a kind of liana with large white blossoms, with a milky sap and apple-like fruits. At the Ssômbo River I was shown a path said to have been made by this animal in order to get at its food. The path was fresh and there were plants of the described type near by. But since there were too many tracks of elephants, hippos, and other large mammals it was impossible to make out a particular spoor with any amount of certainty.

Mentions of a mysterious aquatic, large, and probably reptilian inhabitant of the lakes, rivers, and swamps of Central Africa are not at all hard to find. The Hottentots along the Oranje River talk about something which they call *groot slang,* Dutch for "big snake." Officers of the Victoria Nyanza steamers think they saw a long-necked beast in the lake. Sir Clement Hill told that he saw, near Mt. Home on the Victoria Nyanza, a large animal rise out of the water and attempt to seize the lookout. Sir Clement stated that the animal had a small head on a long neck and that it swam fast with its forepart well out of the water.

While such mentions, of which Sir Clement's is unusually precise and definite, are numerous, it is hard to find anything beyond such passing references. Even Frank W. Lane unearthed only a very few reports. There is, to begin with, the story of an animal called *lau* which can be found in the book *Far Away Up the Nile* by John G. Millais. Millais' reporter was a certain Sergeant Stephens who firmly believed in the existence of the *lau,* which is said to inhabit the region of the large swamps on the Upper Nile. Stephens claimed to have talked to natives who saw a dead *lau* and to others who had watched

the killing of one. They all agreed that the animal had a yellowish-brownish body, was over forty feet long (some statements said one hundred feet, but some exaggeration is unavoidable since it is almost impossible to guess the length of a generally snakelike animal correctly, even if it is a real snake well known to the observer), having a snakelike head with thick bristles or tentacles. After talking to Stephens for a long time, Millais found the story substantiated—to his surprise, it seems—by a Belgian administrator who claimed to have seen a *lau* in a swamp and fired at it several times, without recognizable success.

The late King Lewanika of the Barotse, according to Lane, had given strict orders to be called in case one of his subjects encountered a *lau.*

> One day three men rushed into Lewanika's court house and told him with great excitement that they had just seen the monster lying at the edge of the marsh. The men said the beast had a long neck and had a head like a snake. When the creature saw the men, it had retreated on its belly and slid into deep water. Lewanika went at once to the place indicated and saw that for a large space the reeds had been flattened down. A broad path led to the water's edge, and water was still flowing into the recently disturbed mud.
>
> Lewanika was so impressed that he made an official report to Col. Hardinge, the British Resident. In the report Lewanika described the "mystery" as "a monster with a head like a snake, making a huge track in the reeds as large as a full-sized wagon would make were its wheels removed" (i.e., a track about 4½ ft. wide).

While it is unlikely that a native king would make a report to the British Resident without good reasons, it is still possible that the *lau* is not the same as the *mokéle-mbêmbe* or the *sirrush.* But there is a great resemblance between the latter two and the *chipekwe* about which the author of the book *Eighteen Years on Lake Bangweulu* (the author, J. E. Hughes, prefers this spelling) reports. Hughes talked to the son of the chief of the Waushi tribe, who told him that his grandfather had either taken part in or at least witnessed a *chipekwe* hunt.

> A good description of the hunt has been handed down by tradition. It took many of the best hunters the whole day spearing it with their large Viwingo harpoons—the same as they use today for the hippo. It is described as having a smooth dark body, without bristles, and armed with a single

smooth white horn fixed like the horn of a rhinoceros, but composed of smooth white ivory, very highly polished. It is a pity that they didn't keep it, as I would have given them anything they liked for it.

Hughes also knew a Rhodesian administrator who told that he one night heard a tremendous splashing in the lake near which he was camped that night and that he found a spoor the next morning which he had never seen before.[1]

Now, all these descriptions suggest strongly what they suggested to Hagenbeck: that there is a medium-sized dinosaur alive in Central Africa. Since it seems to prefer swampland which is by its nature not the habitat of humans, it is seen only rarely, and it is quite possible that the animal itself is rare too.

Once this is accepted as a hypothesis there is only one additional question left: could dinosaurs have survived in Central Africa? And the answer to that question is "yes." Unlikely as it may seem, they could have.

The facts to be considered are the following. The age of the large reptiles, consisting of (in that succession) the Triassic, the Jurassic, and the Cretaceous Period, came to a close about sixty million years ago, and since then the better-known parts of the earth—North America and Europe—have gone through extended periods of unrestricted mammalian rule. Right after the rule of the saurians had come to an end, these two continents experienced at first a cool and very moist period—the so-called Cenomanian flood. After that the Tertiary Period followed with a generally warm climate, which was terminated by the Ice Age of four extended glaciations with three intervening warm and very dry interglacial periods. If the dinosaurs had not been extinct before that time, the Ice Age would have finished them. However, contrary to some popular suppositions, the Ice Age had nothing to do with the end of the dinosaurs. What the Ice Age did was to eradicate the abundant mammalian life in the Northern hemisphere.

But all these climatic changes had little effect on the belt between the Tropics of Cancer and Capricorn. Conditions resulting in a glaciation

[1] There are some more reports like this, but in some cases the veracity is doubtful, as for example that of the Belgian Lepage who said he saw such an animal in the Belgian Congo in 1920.

in the north only caused slightly prolonged rainy seasons in the south. The central region of Africa happens to be even better protected against changes than the tropical parts of other continents. Africa is more stable, geologically speaking, than tropical America or tropical Asia. The forces that formed tremendous mountain chains in America and Asia during the interval between the Cretaceous Period and the present era were virtually absent in Africa. Finally, Central Africa is more isolated in another sense. It is known that huge migrations of animals took place during that interval, and newcomers often have habits that spell doom to the older inhabitants. Africa was not completely free of such migrations, but experienced them in a somewhat milder form. Central Africa, with its famous Rainy Forest, is actually the home of various animal forms that go straight back to the Tertiary Period, as will be discussed in detail later on. In short, Central Africa could well be a dinosaur habitat even now, and the stories about the animal *Mokéle-mbêmbe* suggest that it actually is.

Unfortunately we do not know definitely why the dinosaurs perished at the end of the Cretaceous Period. There are several different theories, but all of them blame changes of temperature and climate as the underlying cause. The customary explanation works with the idea of a slight reduction in temperature. Such a slight reduction, it is said, reduced the volume of vegetation, principally of those plants that furnished food to the large plant-eating dinosaurs of the *Brontosaurus* tribe. Thus these dinosaurs were reduced in numbers. As a result the carnivorous dinosaurs, those that preyed on the plant-eaters, also had difficulties in finding enough food, and there began a relentless hunt for the herbivorous survivors until the last of them had been killed. Then the flesh-eating dinosaurs became extinct, too—partly from starvation, partly from fighting among themselves. As yet there existed no mammals to turn to, or rather what mammals there were could not furnish a dinosaur's normal meal, being usually about the size of rats. Besides, they made their homes in places inaccessible to dragons: in burrows, in hollow tree trunks, in nests in tree tops, or between the roots of trees.

This explanation sounds convincing, for there is little doubt that, once a reduction in the number of large plant-eaters took place, such a cycle was inevitable. Plant-eaters can often turn flesh-eaters in a pinch,

but normally it fails to work the other way round. The other explanations for the disappearance of dinosaurs that have found support proceed along much the same lines, differing only in the point at which the cycle begins. For example, it is an established fact that there existed a number of small dinosaurs, about as large as small dogs, that made their living by feasting upon the eggs laid by the big dinosaurs. Also it seems likely that a few varieties of birds of that time developed a fondness for dinosaur eggs; and doubtless some of the early mammals were skilled in that pursuit, too. An increase of small egg-robbers might well have made life miserable and very uncertain for the large egg-layers. As soon as conditions were no longer just perfect for them, they could not maintain themselves against new enemies—the far more recent moas and dodos are examples of how that can happen.

More recently some field work with living reptiles has provided another clue as regards the extinction of the dinosaurs. These experiments have shown that the "thermal tolerance" of reptiles is surprisingly low. They don't mind cold half as much as one would believe, but when subjected to the direct rays of the sun their blood temperature, lacking any regulation by sweat glands, shoots up rapidly and inevitably ends the life of the specimen. These experiments also suggest how a comparatively small change in climatic conditions could have ended the life of all the large forms. All that was needed was the change of a swampy forest into drier plains. The dinosaurs, exposed to sunlight and without cooling water, would have died off literally from heat stroke. In fact, this may account for some of the large accumulations of dinosaur bones which have been found.

Something of the kind must have taken place in Africa too. Africa was once just as much a paradise of dinosaurs of the largest types as the northwestern continent which is now part of the United States. The fact that dinosaur bones have been shipped from Africa not by the truck but literally by the shipload is sufficient proof of their former abundance. The large ones are now as extinct in Africa as elsewhere, but medium-sized varieties might just conceivably have survived, under Central Africa's triple protection of warm climate and resulting tropical jungles and swamps, geologic stability, and isolation from too much immigration.

And this brings to an end the story of the "Dragon of the Ishtar Gate." I have to admit that it is by no means a complete story. It is complete only in the sense that it exhausts the available and reliable material, but the available material is by no means satisfactory. It merely points to the existence of a zoological puzzle of fantastic dimensions. As regards the solution, we'll just have to wait and hope for one.

Part Two

EXTINCT!

But creatures whom Nature with no such gifts had endowed, who could live
By no cunning or strength of their own, nor yet could help our need
With service, in payment for which we might suffer their kind to feed
And to live, within the wall of our protection enclosed
These lay, of a surety, a prey and a booty to spoilers exposed,
Lay as in self-forged fetters of doom, and in evil case,
Till to utter extermination Nature brought that race.

(Titus Lucretius Carus: *De Natura Rerum*,
Book V, 871-877, written between 60 and 55 B.C.)

10: *Urus, Wisent, and Bison*

THE DATE February 19, 1921, marks an important and tragic event in the annals of zoology. On that day one Bartmoleus Szpakowicz shot a wisent or European bison in the forest of Bialowiecza in Poland. It was Europe's last wild wisent.

The European wisent resembles the American bison very closely, which is not surprising since these animals are, so to speak, first cousins. The American bison—the so-called "buffalo"—is, however, the more heavily built in front, and it habitually carries itself somewhat differently; for the bison is a grazing animal and has to keep its head close to the ground, whereas, the wisent's food consists mainly of leaves and twigs of underbrush and young trees.

Bison and wisent are very similar in other respects too. Though living in quite different surroundings on two different continents, separated by three thousand miles of salt water, they have histories that are virtually the same, differing in details only to about the same extent as the two animals differ in appearance and habits. They are alike also in the symbolism with which men have endowed them. To an American the "buffalo" recalls the times of the pioneers, when Indians made it unsafe to venture too far away from prairie settlements. Likewise the wisent, to a European, signifies the time when history was still young, when man was master only within the walls of his cities. In the tilled fields around his cities his mastery was disputed by wolves and occasional bears, and beyond those fields began the dense forest realm where Nature held sway undisputed by man and where every journey became an adventure.

It was these immense forests that confronted the Roman legions when they crossed the Alps—forests where only streams afforded a means of travel, forests alive with strange beasts and unpredictable barbarians who were friendly one day and anything but friendly the next. It was here that the Romans encountered the third of the wild oxen that play a role in human history, the gigantic black urus or aurochs. This animal taxed the imagination of all who saw it or only heard about it. In Roman times it was even more numerous than the wisent, but it disappeared silently and unnoticed just about the time when the first white pioneers in America began to kill off the bison.

In spite of these differences in space and time, the stories of these three, bison on this side of the Atlantic and wisent and urus on the other, belong together. As befits creatures of such impressive characteristics, the history of each of them is connected with some great name in human history; indeed, the very first known mention of each of them was made by a famous man. It is as if history went out of its way to make certain that man's first acquaintance with these animals should seem important.

It seems strange that the discovery of the North American mainland did not result immediately in the discovery of the vast bison herds which roamed the land, for the range of this great shaggy beast covered an immense stretch of territory. As Dr. William T. Hornaday writes:

> Starting almost at tide-water on the Atlantic coast, the bison's habitat extended westward through a vast tract of dense forest, across the Allegheny Mountain system to the prairies along the Mississippi and southward to the delta of that great stream. Although the great plains country of the West was the natural home of the species, where it flourished most abundantly, it also wandered south across Texas to the burning plains of Northeastern Mexico, westward across the Rocky Mountains into New Mexico, Utah, and Idaho and northward across a vast treeless waste to the bleak and inhospitable shores of the Great Slave Lake itself.

Yet the first explorers managed to miss that immense territory, and the first specimen of an American bison seen by white men was a *captive* bull! When in 1521 Cortez and his men fought their way to the Aztec capital, in King Montezuma's menagerie they marveled at

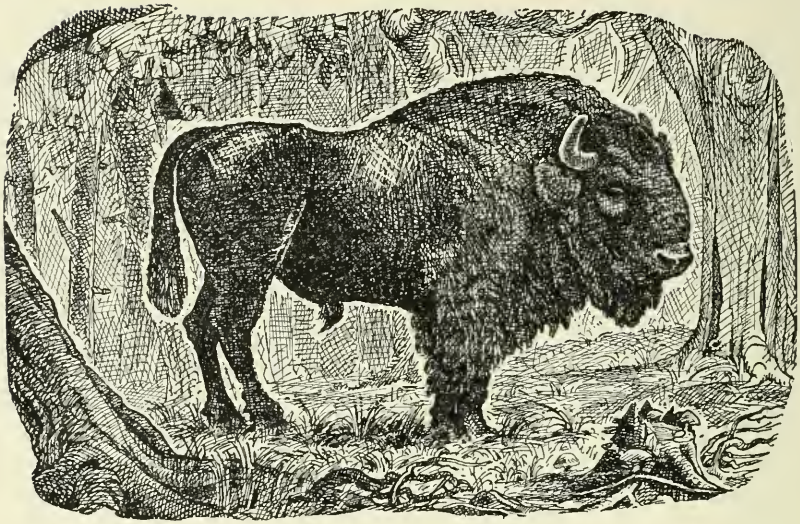
the "rare Mexican bull" with hair like a lion, a hump like a camel, and crooked shoulders. Nine years later Alvar Núñez Cabeza de Vaca saw the first wild bison in what is now Texas, and another twelve years later Coronado reached the real "buffalo country."

The wisent and the urus on the European side of the Atlantic Ocean first became known to literature through the works of Pliny and, mainly, through the *Commentaries* of Gaius Julius Caesar. Caesar wrote at length and with considerable awe about the "Hercynian Forest" north of the Alps, which harbored both these animals:

> The Hercynian Forest is about nine days' journey in breadth. It begins at the confines of the Helvetians, Nemetes, and Rauraci and, following directly the course of the Danube, extends to the territories of the Anartes and Dacians. Thence turning from the river to the left it runs through a multitude of different regions, and though there are many in the country who have advanced six days' journey into this forest, yet no one pretends to have reached the extreme end of it or to have discovered how far it extends.

It was there that the wisents lived, but, even more important, it was also the country of the urus. "Nearly equaling the elephant in bulk," exclaimed Caesar, "although in shape and color resembling a bull. . . . They are of uncommon strength and swiftness," he went on, "and spare neither man nor beast that comes in their way. They are taken by pits dug for that purpose and then slain. This method of hunting is frequent among the youth." While there is hardly any doubt that the meat from slain uri was eaten and the hide used (especially for the making of shields), it was the horn upon which attention centered. Displaying the horns of a killed urus was proof of a memorable achievement and, to quote Caesar again, "they are preserved with great care, their edges are tipped with silver, and they are used instead of cups on the most solemn festivals."

But the wisent attracted just as much attention among the Romans, for with its heavy head and shaggy mane it looked the more wild and ferocious. The urus, though larger, and though many narratives from the North claimed that it was really the more fearsome, did not after all differ very much in general appearance from peaceful domesticated cattle. Soon after Caesar's *Commentaries* became known, both wisent



Wisent or European bison

(Drawing by Gustav Wolf)

and urus bulls began to be sought by Roman noblemen for gladiatorial combats in the arena. The poet Martial has even preserved for posterity the name of the most successful of the classic "bull fighters." It was one Karpophorus, whose strength and whose sword stood up best against the terrors from the Hercynian Forest of the North.

More important to the zoologists of our time than these memories of Rome's glory are the later descriptions of the urus that were made by travelers from the Western European countries, where it no longer roamed, to Poland, Lithuania, and Russia. To them these large, ferocious cattle, the old bulls almost justifying Caesar's exaggerated comparison with the elephant, were a source of never-ending wonder. The females were a dark brown in color, the males a shiny black. Both had a light-colored band running all the way along the back, and white markings around the mouth.

These travelers did not, of course, know that the similarity between uri and domestic cattle had a perfectly natural basis. The urus was the ancestor of domestic cattle, only the domestication had been ac-

complished in Asia. The ferocious aurochs had been pictured on golden goblets in ancient Greece and before that on the gate of the Temple of Ishtar in ancient Babylon.[1] These pictures had been copied by Persians to adorn the walls of the palace in Persepolis, but neither the Babylonians nor the Persians (and, of course, neither the Greeks nor the Romans) knew that it was these animals that had been domesticated as cattle. As we have already seen in our first chapter, for the ancient Jews the reem (the aurochs, translated by the Seventy as the "unicorn") was the very model of an animal that could never be domesticated (Job xxxix:9-12).

On the whole, the huge urus, for all its resemblance to the domestic bull, was much more feared than the stranger-looking shaggy wisent. This may be why so many early writers erroneously used the term "aurochs" when referring to the wisent—the appearance of the latter suggested the reputation of the former. The confusion of names was already prevalent in Roman times. Pliny the Elder remarks that "vulgar people, in their ignorance, call the bison (wisent) by the name of *bubalus* (buffalo)."[2] (This is precisely the error, curiously enough, through which the American bison came so much later to be called a buffalo, an error rather difficult to explain since the East Indian water buffalo was far from being a well-known animal.) And in 1837, Georg Gottlieb Pusch tried to prove in a long chapter of his learned *Polish Paleontology* that such an animal as the urus had never existed, since the word *tur* (the Polish name for the urus) and the word *zubr* (Polish for bison) were simply two forms of the same word. Although the venerable Pusch's conclusion was wrong, his etymology was correct, and so was his skepticism over the references to these two animals to be found in medieval literature.

After a short literary glory in Roman times, the story of the two European varieties of wild cattle lapsed into obscurity and confusion for a full thousand years. This does not mean that they were not mentioned occasionally, for they were, usually in connection with a royal hunt or in a description of the food served at some celebration;

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[1] See Chapter 9: "The Dragon of the Ishtar Gate."

[2] The Latin *bison* (pronounced *beezon*) is probably directly derived from the German *wisent* (pronounced *veezent*), just as *urus* is probably a Latinization of *aurochs*.

but it is hard to tell exactly which of the two animals was hunted or eaten at a certain place at a certain time. The chroniclers seem to have used the terms wisent and aurochs interchangeably; and only when both are named together—as, for example, in the famous lines in the *Nibelungenlied*—can we be certain that both types were properly distinguished:

Darnach sluog Sivrit sciere
einen Wisent und einen Elch
Starker Ure viere
und einen grimmen Scelch.

(Thereafter Siegfried killed
a wisent and an elk [moose]
And then four sturdy uri
and one ferocious shelk.)[1]

For many centuries, if we count from the time when wisent and urus were first seen by Romans, the animals occurred in many places all over their original range. But they covered their range more and more spottily, the herds grew smaller and smaller, and each herd became more and more isolated. One "successful" hunt meant, in the end, their extinction in a large area.

At first the wisent appears to have receded even more rapidly than the aurochs, although the latter was already extremely rare in sixth-century France, where it was game for the king alone. A thousand years later both animals were as far removed from the eyes of the civilized world of Western Europe as they had been removed from Rome when the legions began the conquest of the northern countries. Konrad Gesner, writing in Switzerland in 1555, remarked that the urus could be found only in Lithuania, "where the inhabitants wrongly called him the German wisent"; while the wisent was found only in East Prussia, Poland, and Hungary, although "a long time ago it inhabited the Black Forest." When Gesner wrote his chapter on the urus there were only about thirty of them still alive. That small herd shrank to four head by 1602. These lived in a state of semi-domestication near Jaktorovka in Masovia. One by one they perished; the last

[1] The term shelk denotes a male wild horse.

survivor was an old female. And when she was found dead one day in 1627, the *aurochs* of the Germans, the *urus* of the Romans, and the *tur* of the Poles had ceased to exist.

Wisents were still fairly numerous then, but the advance of civilization, which destroyed the dense forests they loved, forced them farther and farther to the east. Around 1730 the wisent was definitely rare even in those countries Konrad Gesner had called their home, except in Poland. It became more and more difficult to catch wisents for the so-called "animal combats" which were then in vogue. The Prussian King Frederick the Great, who did not care for that kind of amusement and did not want his subjects to care for it either, curtly issued a *verboten* and gave the land used for that purpose free to anyone who would sign an obligation to build a house on it. But Frederick also did not want this spectacular animal to disappear completely from his country. He assigned two or three hunters to take care of a small herd that was known to live not far from Tilsit in East Prussia. But during the long and severe winter of 1742 most of this herd perished, and the few survivors succumbed later or were poached, the last one in 1755. From that year on the wisent existed only in territory that was either Polish or Russian.

It seems, however, that the animal suffered even in these districts. Slowly the wisents began to concentrate in one particular spot, the forest of Bialowiecza as the Poles, or Byelovyesh as the Russians, called it.[1]

The forest of Bialowiecza was actually a remnant of Caesar's Hercynian Forest; and its origins went directly back to the last glaciation. Zoologists knew that the wisent needed dense forests to thrive, and since the veritable forest primeval of Byelovyesh was practically impenetrable, they did not worry much about the future of the species. What worries they had were dispelled when, on October 10, 1802, the Czar of all the Russias issued a special ukase (in French) to the effect that, *"considérant la rareté d'une espèce de gibier, nommé Zubr,"* the felling of trees in the forest of Byelovyesh was prohibited without any

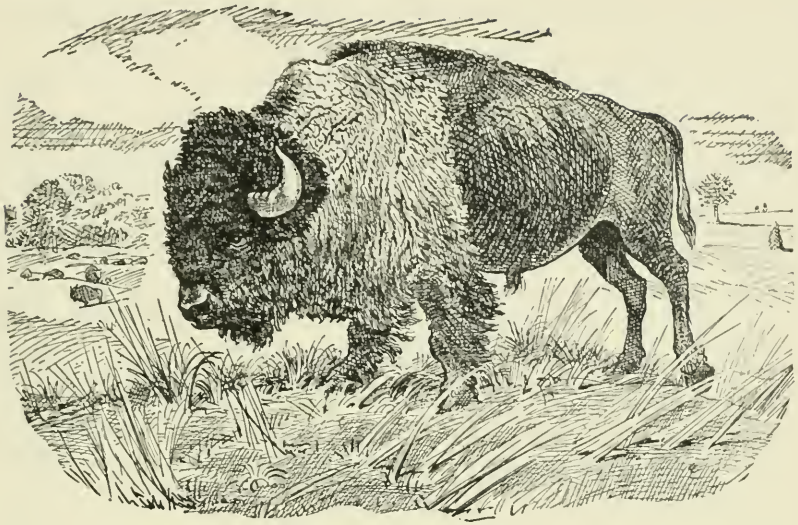
[1] There exists also a rarely used German name for this locality. It is *Weissenturm* (White Tower), merely a translation of the Polish name, which is supposed to stem from a legend about an enchanted castle of white marble in that forest.

exception so that the forest itself and its animals might be preserved.

There was really a considerable number of wisents left. In 1829, seven hundred and eleven head were counted, in 1830 seventy more. Then the number dropped for no known reason, but in 1853 about fifteen hundred wisents were living in the forest. That high number was not maintained for long, however, for the ukase of the Czar had not been promulgated for entirely unselfish scientific reasons. The Czar had wanted to protect the wisent as a very special game animal for himself and his children, and for hunting trophies for honored guests. Of course, no great harm was done by the shooting of a few wisents each year; what probably did the harm was that for hunting purposes all other kinds of game animals were brought into the forest in large quantities. For a while the wisents threatened to succumb entirely and Russian zoologists were very much puzzled about it. The wisents were even provided with special and expensive fodder, and the administration saw to it that this was not stolen. Foreign experts finally explained that it seemed to be just this exaggerated care that was harming the wisents. Whether their advice was followed I do not know, but the fact is that the wisents soon gained in numbers again and stabilized at about seven hundred and fifty head.

Meanwhile the scientific world had been surprised by the unexpected news that there existed a second fairly large herd of wisents, though not strictly in Europe. When, around the middle of the last century, the Poles revolted against their Russian masters, there were also Caucasian regiments among the Russian troops that fought the Poles. At the end of the war, one of the Caucasian lieutenants visited the museum in Lublin and saw a specimen of the Bialowiecza wisents. He at once informed the museum authorities that he knew that animal from his native mountains. It was then found that there did indeed live in the Caucasus a herd of a somewhat different variety of wisents. It is uncertain how many there were at the time they were discovered, but an official Russian census for the year 1914 gives their number as between 650 and 700 head.

European zoologists were fairly well pleased with the *status quo;* for no matter how much they loved their wild ox, they could not very well expect an animal of its size and habits to roam all over heavily



American bison

(Drawing by Gustav Wolf)

industrialized and intensely cultivated tracts of land. Adding up their animals, they arrived at a comforting figure: about 750 wisents lived in the enchanted forest of Bialowiecza; about 120 lived in smaller herds on the estates of various Russian and German noblemen; several dozens were in zoological parks all over the world; and about 700 of a slightly different variety roamed the Caucasus Mountains. There appeared to be no cause for worry.

They were much more concerned over the American bison. The Americans had been a little too efficient as hunters—now only a miracle would keep the bison alive at all. As everyone knows, the American bison was saved from extinction—but only because American scientists did work a miracle.

No one knows how many bison lived on the vast North American continent when Cortez saw the "rare bull" in Montezuma's menagerie. There certainly were many more bison than men in America, and the fact that many Indian tribes lived almost exclusively on the buffalo, taking from it meat and skin, wool and horns, in fact everything it

offered, did not make the slightest impression. Colonel C. Goodnight, in a letter to Martin S. Garretson (to whom we owe the best book on the American bison), gives the following report:

> During the Civil War, I passed through that vast herd of southern buffalo many times. I do well remember that vast herd of buffalo. It was probably twenty-five miles through and fifty miles long and as thick as they could graze. . . . Our Command moved up on a slight eminence, and as far as the eye could reach, North, South, and West, a distance of not less than ten miles in either direction, the whole country was covered with what appeared to be a monstrous moving brown blanket, the length and breadth of which could not be determined.

When immense herds like that crossed rivers, steamboats had to wait; when they crossed railroad tracks, trains were delayed for a day or more. The railroad engineers also had another reason to dislike the bison. The animals enjoyed rubbing their massive shoulders against rocks and trees; in fact not many trees survived where the bison was abundant. When telegraph posts came, the bison welcomed the innovation, only they found them very weak rubbing trees. The engineers, in desperation, put sharp spikes on the poles. The bison liked them even better thereafter.

It was the railroad that spelled doom for the bison. All the previous hunting by whites and Indians had not noticeably diminished their immense numbers; but with the advent of the railroad the commercial slaughter began. There now existed a means of transporting the "buffalo robes" from the bison country to the centers of commerce in the East. The first transcontinental railway divided the bison into a southern and a northern herd, the former being more numerous (even in 1871 a herd of four million head was encountered near the Arkansas River between Fort Zara and Fort Larned), the latter having more territory. Consequently the southern herd was the first to be exterminated. In 1871 the Atchison, Topeka, and Santa Fe Railroad had been built as far as Dodge City, Kansas, which then became the center of the hide hunters. There were about five thousand professional bison hunters at work and just as many pleasure hunters, some accounting for about sixty bison every day! In one district alone two hundred and ten thousand were killed in two months. Small wonder that even the Big Herd

lasted for only a few years. A hundred thousand were killed in the winter of 1877–78. That was the end of the southern herd; the remnants fled to the Staked Plain in Texas. Ten years later fifty-two bison were killed near Tascosa in Texas. The last four animals of the southern herd were shot in 1889 near Buffalo Springs, Texas.

In 1875 the states of Kansas and Colorado had passed laws to protect the bison, but it was now too late. And Texas, where such a law would still have been useful, did not move. When a law for the protection of the bison was brought before the State Legislature in Texas, General Phil Sheridan addressed a joint session of the legislative bodies and declared that the bison hunters deserved medals showing the picture of a discouraged Indian. Even if extermination of the bison should be the price for perpetual peace with the Indians, who would then be starved into submission, the price would be low. "The buffalo hunters have done more to bring about peace with the Indians in a few months than the whole Army could do in thirty years!" Texas did not pass the law.

After the southern herd had ceased to exist, the hunters went north to exterminate the northern herd. There was a ceaseless slaughter of bison on both sides of the Yellowstone National Park. The number of hides transported by the Northern Pacific Railway tells the story of the northern herd in a dramatic form. In 1881 there were fifty thousand hides to be shipped; in 1882 the figure rose to two hundred thousand; in 1883 it dropped to forty thousand; and in 1884 there were only two carloads.

Meanwhile the Indians were themselves contributing to their own ruin. In about two months in the autumn of 1883, one entire herd of about ten thousand head in North Dakota had been hunted down by Sitting Bull and his followers. That was the last great Indian bison hunt. After that the Indians were starved into submission and had to stay on their reservations, just as General Sheridan had prophesied. The Federal Government also refused to do anything to protect the bison; there were some members of Congress of General Sheridan's opinion; and it seems that President Ulysses S. Grant belonged to the same "party," for he pigeonholed for the duration of his term of office a law that had finally been approved.

But the bison was nevertheless saved. At the end of 1899 only two groups of bison were left in America, a small herd in Yellowstone Park and a larger number in Canada. The latter consisted in part of remnants that had fled the slaughter in the United States, but mostly they were the so-called "wood buffalo," which are somewhat larger and heavier than the "plains buffalo" but do not constitute a separate zoological species. They had been protected by a Canadian law in 1885. Dr. William T. Hornaday of the New York Zoological Park took a census in 1889 and found that there were exactly 1091 bison alive, counting the Yellowstone and Canadian herds, the specimens in zoological parks, and those kept by some wealthy ranchers. Hornaday then founded the American Bison Society, which gained the friendly support of President Theodore Roosevelt. The efforts of the society met with success: in 1910 there were 2108 bison in North America; in 1920 these had multiplied to 8539 head; and ten years later there lived about 10,000 more. The census of 1933 shows 21,701 pure-blood bison—4404 in the United States, 17,043 in Canada, 46 in Alaska, 3 in Mexico (the Zoological Park in Mexico City), and 205 in zoological parks in South America and Europe.

When in 1914 the numbers of American bison had increased to about the same level as the figures for the European wisent, it was felt that the bison was saved. It had been a tragedy, but the unhappy ending had been avoided. Too bad the urus was extinct, but that had happened a long time ago and could no longer be helped. At least the bison and wisent were safe.

Or so it was thought.

In August 1914 the First World War began. The forest of Bialowiecza was not very far from the Russo-German border. About one year after the outbreak of the war the battlefront began to move in the direction of the last important refuge of the wisent. In the spring of 1915, when it became certain that the Russian troops in that sector would not be able to resist the push of the German armies much longer, the Czar paid a last visit to Bialowiecza, where there were then 770 wisents. Soon after, the men battled in, around, and about the large forest, and the Germans finally took it in September 1915, after prolonged fighting, with heavy losses on both sides. The heaviest losses

were those of the wisents. When the battle of the men was over—a battle that looked, as far as surroundings were concerned, remarkably like those ancient German-Roman encounters in the Hercynian Forest —only a very few wisents were still alive. The herd was dispersed, only small wandering groups were left.

German zoologists, to whom the word Bialowiecza meant more than a spot on the map near the front lines, penetrated in a forced reconnaissance attack of their own, the surrounding rings of undersecretaries and secretaries and approached the High Command itself, General Field Marshal von Hindenburg and Prince Leopold of Bavaria. The result was a provisional order issued immediately, followed some time later by an order to all the armies in the Eastern Sector. Subject: protection of the wisent. Method: a special staff of zoologists and foresters under the command of an expert who also held the rank of a high officer.

A census was taken first which showed that there were still about 120 wisents alive. Some sources claim that there were 150; that is an error, caused by a group of about thirty animals' having been counted twice. Although a rigid organization was formed, it could not keep the soldiers from poaching seven or eight animals. A dozen old bulls were shot, one by one, because it was observed that, although already sterile, they monopolized wisent cows and prevented younger bulls from mating with them. In spite of this loss of about twenty animals the herd increased. During the time of the German occupation from September 1915 till November 1918, the number mounted from 120 to 185 head.

But in November 1918 the German troops were withdrawn. A plan to remove the wisents to safer territory in the hinterland had been much discussed and a number of preparations had been made, but the plan could not be carried out. Wilhelm II was still Emperor of Germany and he ruled that the wisents could not be touched, being the private property of the Czar. This was the death sentence for the wisent. Later it was found that the assumption had been erroneous and that nobody in particular had ever been the legal owner of the animals.

When the German armies withdrew, peasants began to kill the

wisents systematically, not so much for meat as for their hides. And hungry soldiers on both sides helped to hasten the work of destruction. A few lone survivors escaped for a time, but they were poached one by one until—in defiance of the strict orders issued by the young Polish government—Bartmoleus Szpakowicz, who had been a forester at Bialowiecza in Russian times, shot the last one.

Meanwhile the other herds had suffered much the same fate. The Caucasus herd fell in the Russian Revolution to the last head, as Soviet surveyors found out later. The herd at Tachina Park (near St. Petersburg), numbering thirty animals, was shot by the Cossacks who were supposed to protect it. The Crimean herd was killed for its meat; a herd near Minsk of about five animals was shot by Red soldiers. No wisent on Russian territory survived the Russian Civil War. But there was still a large herd left, numbering 55 head, stemming from one bull and three cows that had been given to the Prince of Pless in 1869 by Czar Alexander II. The estates of the Prince of Pless were divided between Poland and Germany, and the herd of wisents lived on the Polish, or major, part. But then Poland underwent some revolts and the mob began to shoot at the wisents with machine guns. The Prince of Pless asked to be allowed to remove the animals to that section of his estate that was German and quiet, but permission was refused because it would have been tantamount to an admission by the Polish government that it could not maintain order. When it finally did re-establish order the wisents were dead; only three survived and each of them had several machine gun bullets in its body.

It looked as if the story of the wisent had reached its last page. But scientists are stubborn people. They do not give up—not even *after* it is too late, as we shall soon see in the case of the aurochs. There were still some wisents left, widely scattered and apparently not very young and healthy and useful—but they were alive. And the example of the American Bison Society was very encouraging.

The International Society for the Conservation of the Wisent was patterned after the American Bison Society; its founders expected to accomplish another "American miracle" for the wisent. There were, however, a number of differences. When the American bison had been at its lowest ebb, in 1889, Dr. Hornaday's census had shown that there

were still 1091 specimens alive, about three-quarters of them in Canada, most of the rest in the United States, and only a very few in the zoological gardens of foreign countries. The Wisent Society had only about fifty animals to work with, unfortunately almost half of them bulls. This was because they were zoo specimens, and every zoological park had naturally tried to show a male as well as a female. For purposes of breeding, however, the ideal proportion would have been five cows for every bull. That these fifty animals were scattered through fifteen different countries did not help matters. Finally, despite its appearance, the wisent was not an exceedingly robust and healthy animal. When the American bison was practically exterminated by hide hunters within two and a half decades, the disaster had descended upon a healthy race; the thousand survivors had been for the most part sturdy animals. The fifty wisents came from a race that had slowly but inevitably receded for centuries, and even the healthiest and sturdiest among them were probably feeble compared to their ancestors of Roman times. They were all more or less "tame," that is, used to the presence and care of men.

The Wisent Society's first task was to count what was left. The figures of that census were frightening: 56 living animals, 80 mounted museum specimens, the same number of mounted skeletons, and 120 skulls. While the work to keep the wisent alive was still in its initial stage, the number of living wisents dropped still further when a small, privately owned German herd of five succumbed to disease. Similar losses continued to occur during the next few years, so that in spite of the increasing birth rate the total number did not rise. It was still 60 in 1930, and less than half of that number were cows.

The job of keeping the name of the wisent from the list of extinct animals was entrusted mainly to the brothers Lutz and Heinrich Heck, directors, respectively, of the zoological gardens of Berlin and Munich. Dr. Heinrich Heck of Munich was responsible for the plan to add some American bison blood to the stock, a plan which had been severely criticized in various quarters. In the summer of 1939 I wrote to Dr. Heck, asking him for the number of wisents now alive and also about the method of cross-breeding with bisons, and his reasons for doing so. He replied in part: "I am happy to inform you that last year

[1938] the number of living wisents for the first time climbed above the hundred mark."

As to the much-debated question of cross-breeding, Dr. Heck explained that the society was afraid that the species might become extinct notwithstanding all its efforts. A mere doubling of the wisent population in twenty years—considering the rate at which cattle normally breed—was not any too encouraging.

Thus we concluded that bison-wisent hybrids were better than no wisents at all. Bison and wisent are not two distinct zoological species, but geographical sub-species of the same species, about as if you mated an American red fox with a European fox. It is therefore not merely a wild experimental crossing of different animals—as it would have been if, say, domestic cattle had been used—but the mating of specimens of two different races of the same species.[1] The scheme of cross-breeding used makes it impossible for the hybrids to separate according to Mendel's law because hybrids never are crossed among themselves. The bull used is always a pure-blooded wisent (available because one bull suffices for a considerable number of cows, but all types of cattle produce about the same number of male and female calves) and it is easy to calculate how quickly the percentage of bison blood will recede.

After reporting that, as far as appearance is concerned, not even experts could distinguish hybrids with a high percentage of wisent blood from pure-blood wisents, and explaining that these hybrids are more adaptable than either wisent or bison as regards diet, Dr. Heck concluded:

Of course, these hybrids always will be strictly distinguished from the pure-blood wisents. If additional wisent parks should be established we will not use pure-blood wisents from the outset any more. We lost too many animals that way after the World War. Too often there are factors involved that men cannot judge. Our principle now is that new localities will be populated by hybrids. They will permit us to judge whether the place is good for hundred per cent wisents. If so, the hybrids will be captured and replaced by wisents; then we'll be certain that there are no hidden parasites or disease germs in the landscape in question.

It was one of the little ironies of fate that this letter was delayed in the mails and reached me on the exact day of the outbreak of the

[1] Most zoologists consider wisent and bison as distinct, although closely related, species.

new European war. Just when it seemed that the animal might be saved after all, politics intervened again. I could not help but wonder whether all the effort and money spent to get the wisent through the aftereffects of the war of 1914–18 would result only in its final extermination in the new war. The then still existing wisents were reasonably well distributed in various European countries. Partly this had been the result of the histories of the various individuals, partly it was planning, because it was deemed desirable that the local groups should inbreed to some extent so that "new blood" from elsewhere would be really "new" blood.

There were the German Schorfheide wisents and a number of zoo specimens in Germany and in other European capitals. Finally there were a few small herds, one near Visegrad in Hungary, several in Sweden (the one at Lansoe being probably the largest), and one on the estates of the Duke of Bedford in England. Although there is not too much information available yet, the majority of the German and Hungarian wisents will probably have to be crossed off the lists. But the animal is not yet lost, although one may harbor grave doubts about continued preservation.

Some information about the present status of the wisent was furnished by the Duke of Bedford in a letter to *Natural History Magazine,* written on April 29, 1946 and published in the June 1946 issue:

> . . . it is stated on good authority that a small pure-bred herd of European wisent, containing several young females, exists in Germany and is being protected. There may be another small herd in Poland, two or three in Sweden and about the same number in the Zoological Gardens at Amsterdam. In England there are 21, of which I have 20, but I am sorry to say they have bred badly for many years and only one or two living calves appear in every season. A heifer was born yesterday and I hope it will survive. We have never had any cross-breds.
>
> One curious difference between the American and European bison is that the European calf is dark brown at birth, whereas the American calf is yellowish-red. The European bison is a more silent animal than the American, though the voice is somewhat similar. Both species enjoy rolling in the dust as well as in the mud.

When things looked as if the wisent were certain to be saved, memories of the urus cropped up again. It was thought a pity that there

had been no modern conservationists around at the time of Konrad Gesner. There were still some thirty uri at that time, and with modern care and methods they might have been perpetuated. Of course it was too late, there was not even the slightest hope of ever discovering a live urus anywhere. One could only look at domestic cattle and think of the urus that had been their ancestor. Then someone had a perfectly fantastic idea. Those cattle had been bred from uri; why not try it the other way round and breed uri from cattle? Such an idea of purposeful breeding for the purpose of reconstructing an extinct ancestor was, needless to say, much too fantastic and could be dismissed without further discussion.

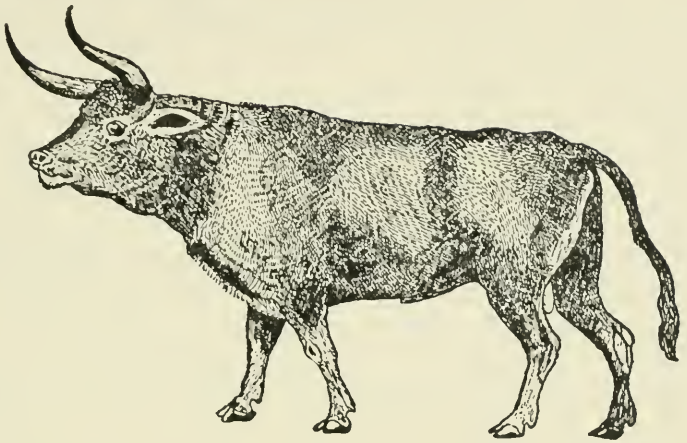
Yes, but . . . it was done!

There were live uri again.

I do not know whether the Brothers Heck were the ones who conceived the thought or whether it sprang up as an accidentally workable idea in the brain of some "race-conscious" Nazi. At any event the Brothers Heck went to work on that scheme and got results.

After it was done, the incredible-seeming re-creation of the urus looked almost like a simple achievement. The situation prevailing after 1627 may be likened to a famous painting by a great artist that had had to suffer partial repainting for many centuries, undertaken to suit various and varying purposes, until at last nothing of the original painting was any longer visible, save for traces of the original outline. But a skillful expert, knowing that the original is hidden under several later coats of paint, may undertake the job of restoring that original, especially if he can find a guide in descriptions made when the original could still be seen.

The great master artist in the case of the urus was Nature herself; the later painters were the various breeders of domestic cattle. Their efforts changed the shape and the size of the animal, its color, and the appearance of its horns; they even distorted the proportions, if this suited their particular purposes. Some needed more meat, some wanted ferocity for bull fights, others bred for milk production. But no matter how much habits, traits, and appearance were changed, the ancient blood (with all its undesirable qualities) was still there. It remained to get it out to the surface again. The main difficulty was to know



Urus (*Bos primigenius*); redrawn from a Polish painting of the late sixteenth or early seventeenth century. The original is probably from life; artist unknown

in every instance which of the characteristics that might emerge in the course of the experiment were "original" and which were later additions.

Fortunately the urus had several times been described in some detail while it was still alive. Though Gesner's woodcuts and those in Baron von Herberstain's *Moscovia* (published in 1556 in Basel) do not quite satisfy either our present-day artistic standards or our interest in detail, an oil painting by an unnamed Polish artist helped considerably in visualizing the real aurochs.

Zoologists were certain, therefore, that they would recognize a urus if they saw one. But to produce one seemed another and very difficult, if not impossible, task. Some even argued that it would be foolish to waste the time and the money needed for such an experiment. In the first place, they said, the whole scheme could not succeed. And, in the second place, if it should succeed, it would still not be a real urus but merely an animal that looked like one. The latter argument was, of course, not quite true. One might conceivably breed a dog that looked like a lion—some chow dogs do, almost—but it would still be a dog. But a dog bred back to acquire the appearance and traits of its

wolflike ancestor would to all intents and purposes be the ancestor, and could again be used to breed all the artificial exaggerations that we term the races or breeds.

Now there exist some races of domestic cattle that still show a few of the features of the extinct urus. The Spanish bull displays the same shape of horns; the cattle of the Hungarian *pusztas* approximate the size of the urus and show the same type of skull structure. And occasional throwbacks to the original coloring of the urus—Scottish Highland cattle do *not* show this coloring, as was believed for some time—can be found in almost any race.

When the experiment was finally begun, it proved to be, to quote Dr. Heck, "much easier than I had thought. It seems to be a smaller task to breed a reconstruction of the old aurochs than to produce a first-class milch-cow. However, that is not so very strange, because cattle in its natural state looked like the urus for millions of years while the changes wrought by domestication are only a few thousands of years old."

That this statement is true was proved also by another fact. Dr. Heinrich Heck selected mainly Hungarian plains cattle for his work. His brother experimented with Spanish and French breeds of fighting bulls. But the results looked so much alike that it required the knowledge of individual characteristics of the animals to tell the two "lines of approach" apart. More important still is the fact that photographs of the modern uri and drawings of the last Polish uri can be placed side by side and presented to anyone not aware of the actual facts as different pictures of the same individual.

Thus even the tragedy of the urus acquired something like a happy ending. And there is not even much reason to worry about the fact that the few specimens which had approached the urus closely in appearance when the Second World War broke out might no longer be alive. What has been done once can be done over again, the urus can be re-created anywhere if desired—and if Caesar could be brought back to life too and be shown such living reconstructions he would find himself unable to believe that his "Elephant of the Hercynian Forest" had ever been extinct.

11: The Almost Unknown Wild Horse

ALTHOUGH cattle and horse have little in common from the zoological point of view they belong together in many ways. As domesticated animals they are both indispensable—for entirely different reasons—and both have had a profound influence on human history—in an entirely different manner.

Both of them were domesticated quite early, as human history goes, but in both cases the ancestor (or at least the main ancestor) of the domesticated varieties continued to live alongside its tamed offspring and alongside the tamer for many centuries.

Their histories are different in detail as well as in outline, but they are alike in being somewhat incredible. But while the history of cattle, and especially of the few survivals of the ancestral forms, had mostly Europe as its locale, the history of the horse, although equipped with European interludes, is essentially American. In fact we may begin to tell it from an unlikely place, virtually horseless midtown Manhattan.

In one of Manhattan's large hotels there is a ballroom and next to that ballroom there is a taproom with a bar. And on the walls of that taproom there are (or at least were some six years ago) a number of murals depicting scenes from the early history of America.

One of these scenes shows the landing of Columbus. The three caravels rest peacefully at anchor on a very blue sea while Columbus and his men emerge from a rowboat. Natives are present to greet them and what appear to be native servants are bringing presents to the

white discoverers. The chieftains are holding themselves at some distance, *watching the scene from horseback!*

It is all enormously touching but it is also somewhat marred by the nasty historical fact that those natives, servants and chieftains alike—provided they had been present at all on that occasion—would have been scared to death if one of the Spaniards had had a horse aboard and had brought it ashore. For there were no horses in the New World then, and we even know the date when they got here.

They followed quickly after Columbus's first voyage, and we know of a letter from his own hand in which he implores the "Most Catholic Majesties" of Spain to send him more horses, since the Spanish nobles, although sick in bed, refused permission to have their horses used for very necessary work. And it is a well-known historical fact that the rapid conquest of South America, a few decades later, was due mostly to the fact that the horses of the conquerors impressed the natives so greatly.

In 1539 De Soto landed over a hundred horses on the Florida Coast to be used on a westward overland march. He did reach and cross the Mississippi and great pains were taken to get the horses across too. After that was accomplished a number of them got away! Some of them may have met and mated with some of the sixteen horses which Cortez had brought to Mexico some years earlier. There is no way of finding out and it is not too important either. The gist of the story is that the plains of North America were eminently suited for horses but that no horses lived on them when the Spaniards came. But whenever they brought horses from Europe, some of them were sure to get away and to populate the plains. They thrived on the plains, and the Indians quickly lost their fear of them, by 1580 one could actually see chieftains on horseback.

Just to round out the historical account it must be mentioned that the first horses which were brought to South America landed there in 1537 and were abandoned when the colony at Buenos Aires was deserted. They found the pampas of South America as congenial a surrounding as their cousins had found the plains of North America.

Actually all this was merely a very belated homecoming.

Those European horses which crossed the Atlantic in ships of ques-

tionable design and doubtful seaworthiness were themselves merely the remote descendants of animals that had originated in North America. Twice in geological history the horse-tribe had spread all over the accessible world from North America. The strange final result of these migrations was that the horses reached all the continents of the globe, with the exception of Australia and, of course, Antarctica, and that they thrived in all of them—but that they became extinct in the Western Hemisphere.

The story of the horse-tribe is better known than that of most other large mammals. With most of them we have, figuratively speaking, a few pages from a tattered book. We know the order of these few pages, because we can determine their relative ages, but many are missing so far. In the case of the horse, we have the complete book except for a very few pages. The first chapter is missing, but from then on everything is as complete as one could want it, save for some figurative smudge spots and minor tears. Strangely enough, there is a full page missing near the very end, but that has been reconstructed by now.

The missing first chapter could be reconstructed too, mostly because we know how it had to go to lead up to the results with which we are familiar. Since horses are mammals, their origin has to lie ultimately with the first mammals which originated during the Permian period some two hundred million years ago. Their first representatives must have resembled the living Australian platypus in organization, though not in appearance. They were certainly small, not over a foot long. They had blood which stayed warm even if the outside temperature dropped during the night. They probably laid eggs, like the platypus, but suckled their young, again like the platypus.

The next step beyond that stage was the marsupial form of construction, still represented by animals like the kangaroo and our opossum. From those marsupials sprang the first of the higher mammals, of which we'll say only at this point that they are all small and often nocturnal and that all of them lead hidden lives, deeply hidden in some cases since the moles belong to that group. So do the shrews and the European hedgehog—but all that will be told with more detail in the later chapter on the "Origin of the Mammal."

Since the mainstay of their diet are insects and their larvae, they have been called insectivores. Since all higher mammals sprang from them, the horses, too, must have had their origin in the insectivores of fifty-five million years ago. But insectivores are small, therefore their bones do not preserve well and are neither complete nor numerous enough to point at a set of specific remains and to say "this is the ancestor of the horse." But like all other insectivores it must have had five fingers on each hand and five toes on each foot. Now, five-fingered hands and five-toed feet are good for obtaining a firm grip on twigs and grasses and roots, but they are not so good for running.

But the horse specialized in running, and in the process began shedding fingers and toes for the sake of speed. One type may have been four-toed and still five-fingered, another three-toed and four-fingered . . . and at this point we leave the realm of theory and enter that of facts. We have reached the first preserved page of the history of the horse. The three-toed and five-fingered horse ancestor is in our museums, in fact we have four or five almost complete specimens and many single fragments. The geological period to which they belong is known as the Eocene, which is one of the subdivisions of the larger period known as the Tertiary.

That name, of course, means "The Third," but the name is only a hangover from times when it was thought that the past history of our planet consisted of three periods. There were lots more than just three, but the name remained. The Tertiary period, in turn, is subdivided into several shorter periods which, for convenience's sake, we may write down in a short table. The first of these is the oldest, and in each line we have first the accepted scientific name, then a translation of the Greek root words involved in the coining of that name, and finally its duration:

Paleocene	"oldest of the new"	5 million years
Eocene	"dawn of the new"	20 million years
Oligocene	"a little newer"	16 million years
Miocene	"less new"	12 million years
Pliocene	"more new"	6 million years
Total duration of Tertiary Period		59 million years

After this followed one million years of "Pleistocene" (meaning "most new"), also known as the Ice Age. That ended some thirty thousand years ago, at which time we entered what geologists insist on calling "Recent," although written tradition goes hardly back more than six thousand years.

This short excursion into bygone periods and their names was necessary because the history of the horse goes from Eocene to Pliocene, with some special wrinkles in Pleistocene and "Recent."

If a man of today saw the horse ancestor of the Eocene sitting in the grass some distance away he would probably mistake it for a large cat. Of course it had a different head, but in size it was like a big tom. Its name is logical and (by coincidence) also poetical: the horse of the Eocene was, of course, named *Eohippus,* which can be translated into "dawn horse." *Eohippus* originated in North America, like all other horses to come, but it so happened that its remains were first discovered in Europe, to be precise, in England, which naturally lead to the conclusion that it was European. Now we know that it wasn't, and in order to set things straight the European form has been named *Hyracotherium,* even though it was probably the same animal as the American *Eohippus. Hyracotherium* when translated means "the hyraxlike mammal," with reference to the hyrax, or coney, a small creature of uncertain origins which occurs in the countries bordering the eastern Mediterranean.

It would be nice if things were simpler than they are, but the ancestry of the horse does look somewhat like those complicated genealogical tables of noble families which fill the *Almanach de Gotha.* From the European form there sprang a whole group which are called the *Paleohippidae,* the "old horselike animals." Early in the Eocene there were six types of them, but by the end of the Eocene two had already died out. By the middle of the Oligocene they had all disappeared. Europe, which had made such a promising start after *Eohippus* had migrated there from America (presumably via a bridge between the old and the new world which included Iceland) was horseless again.

In America a type called *Orohippus* sprang from *Eohippus,* and *Orohippus* begat *Mesohippus*—since this does begin to sound like a

genealogical table of the Old Testament we might as well use the word too. *Orohippus* had only three digits on hands and feet and so did *Mesohippus,* but it had grown to the size of a sheep.

Up to *Mesohippus* ("the middle horse") all horses, European as well as American, seem to have been leaf-eaters and forest animals. With *Mesohippus* they came out into the open and became grass-eaters.

Mesohippus, to continue the list, begat *Miohippus,* and *Miohippus* begat four different types, of which three are of little interest in this connection because they died out rapidly. The fourth and surviving type was *Parahippus.* Strangely enough, both *Miohippus* and *Parahippus* seem to have been rather rare, which is all the more surprising since horses, if they appear anywhere at all, always appear in whole armies. We don't know what did it, but there is a suspicion on file: those layers have also yielded a fossilized tse-tse fly. Those flies are the carriers of the terrible "sleeping sickness" in our time. Of course we can't tell whether they always did, but until we know more (and possibly "better") we may imagine the horses of America endangered by sleeping sickness. But they did not succumb; the next type, *Merychippus* was fantastically abundant again. From *Merychippus* the line runs to *Pliohippus* (the name is a reference to the Pliocene Period, actually it came quite some time earlier), and from there to the true horse *Equus.*

But prior to *Pliohippus* a group branched off which swiftly conquered the world. Its name was *Hipparion,* and it must have been a most beautiful animal.

In size it stood about midway between pony and zebra, in build it was as light and graceful as an antelope. And although one can't guess at the fur from the skeleton, one gets the impression that its pelt must have been sleek and shiny. In numbers it surpassed anything ever seen before. *Hipparion* did not have single hooves like our horses, because on each foot there were still two additional small hooves, dangling from the wrists and ankles and rarely, if ever, touching the ground. *Hipparion* was still three-toed, if you look at the picture, but for practical purposes it was already one-toed, since the big middle hoof did all the actual work. It must have been as fleet as any hoofed animal ever was.

Originating in North America, it spread over the world, which at that time did not look quite as it does now. I am not speaking about the animals nor about the vegetation—which must have resembled that of our Southern states—but of the map itself. As is the case today, Antarctica and Australia were isolated continents, but so was South America, since Central America was then blue water. Africa was also isolated, the connection at its northeastern extremity was nonexistent, and the Strait of Gibraltar was a wide sea. But North America was attached to Asia across the Bering Sea and that was the route followed by the *Hipparions.*

Hipparion and its relative *Neohipparion,* joined by one variety of *Merychippus* (*M. matthewi*) that was still around, crossed over into Asia and rolled like enormous living waves all across Asia and Europe. The immense herds of zebras which were described by early African settlers might be cited for the purpose of giving an impression of these endless millions of horses galloping across the Asiatic continent. The remains of *Hipparion* are so numerous that European paleontologists refer to certain areas in certain times as "hipparion faunas."

But at the end of their spectacular conquest of all of North America, Asia, and Europe the *Hipparions* simply died out!

It is all the more mysterious since the great wave of *Hipparions* had been preceded by a three-toed forest horse (*Anchitherium aurelianense*) which lived throughout Asia and Europe during the early Miocene. Like the *Hipparions,* it had come from North America . . . and became extinct before the *Hipparions* arrived.

But in America, *Pliohippus* had meanwhile progressed to *Equus,* the true horse. At this point another type branched off, called *Hippidium.* It had an exceptionally long, narrow, and sharp nose, which one may assume had a special function, but what it was is still mysterious. During the late Pliocene, South America and North America became joined together. Result: an invasion of *Hippidium* into South America. There were three main types of *Hippidium—Hippidium, Onohippidium,* and *Hyperhippidium*—and also some early true horses which lived in South America.

By the end of the Pleistocene they were extinct!

Shortly after the *Hippidium* invasion of South America another

wave of horses moved from North America into Asia and from there into Europe. And since there existed now a land bridge from Asia and Europe into Africa, they invaded Africa too.

These were true horses, of which the African zebras are remnants, as well as an Asiatic form of which we are going to speak soon. All of Europe was full of horses of the last invasion from America, and primitive Man, who had progressed to the status of living in caves, making fire, and dressing in skins, had also progressed to the status of painting pictures on the walls of his caves. While the colors used are primitive natural pigments, the artistry is so high that certain modern painters would do well if they could only equal them. And many of these pictures show horses, well-drawn, beautiful horses; one long-dead artist even made a perfect sculpture of a horse's head, the material being ivory from a mammoth's tusk. These pictures may have had the purpose of being "hunt fetiches": one might imagine that they ceremoniously and symbolically killed the picture in order to assure their luck in killing an actual horse while hunting the next day.

While this was going on in Europe the horse died out in South America, permanently, this time. It was permanent—until reintroduced by Man—because they could not get a new supply from North America. The horse had died out in North America too!

Nobody has even a guess to offer how that came about.

True, the Pleistocene was the period of the great glaciers, but these glaciers did not cover the whole continent and it was reasonably warm in California through the whole period. Also, California is rich in fossils of these horses; they actually lived there. Besides, the climate of Europe north of the Alps was considerably worse than the climate in America south of what is now the Canadian border. And the horse endured in northern Europe.

While we don't know the reasons, we are sure of the facts, and that has to be that, for the time being.

And now we come to the other missing page.

During the European glaciation the horse was an animal that was hunted, like elk and boar and deer. Then there is an interval of some thirty thousand years without records. When the horse emerges again

it is in the full light of historical tradition. When Man began to write he also wrote of horses, and there were already special breeds. And while horse meat is excellent for food, the horse was rarely eaten in historical times, probably for the very simple reason that it was too valuable otherwise. And an old horse, like an old cow, is poor food.

And when, say two hundred years ago, zoologists began to look at

Equus przhevalski

(Drawing by Olga Ley)

the horse and to think about its wild ancestor, they could not find it. There were some wild asses in Asia and there were the various zebras in Africa. They were decidedly not the ancestors. The "wild horses" of the North American plains were, of course, not wild at all in the true sense. They were ex-domesticated horses, or, as zoologists call the wild offspring of domesticated animals, they were "feral."

The darkness and uncertainty surrounding the origin of the domesticated horse began to lift in 1880. In that year a Russian *Rittmeister*

(colonel of the cavalry) who had turned explorer reported the discovery of a wild horse in Inner Asia. The name of the explorer was Nikolai Mikhailovitch Przhevalski and the horse he discovered is therefore known as *Equus przhevalski,*[1] the name given to it by the Russian zoologist J. S. Polyakov. It is interesting that Przhevalski, in spite of his career as a cavalry officer, first thought his discovery to be a wild donkey; Polyakov convinced him with difficulty that it was a horse. Przhevalski reported that the Kirghiz tribes called the animal *Kertag,* while the Mongolians referred to it as *Taki.* It is a small animal with rather large head, reddish-brownish in color, a brown mane, and a body color of somewhat indeterminate whitish and grayish tints. It has comparatively heavy legs.

In spite of the fact that *Equus przhevalski* was indubitably a wild horse, a leftover of the large herds of horses which had constituted the last wave of wild horses coming from America, it was also pretty clear that the Przhevalski horse had little to do with the domesticated horses of Western Europe. They had to go back more directly to the various types known to have lived at the dawn of civilization. Slowly, very slowly, it became clear that of the various types of the Ice Age two had survived into human history. One was a horse of the open steppes, with a habitat reaching from Western Europe to the Eastern Gobi desert in Asia. That was Przhevalski's horse, which had survived at the eastern rim of its habitat of old.

The other was a forest horse, of almost uniformly mouse-gray color, with a short blackish mane and tail, and with a very pronounced black stripe running along its spine. It was much lighter in build than the Przhevalski horse. This mouse-gray forest horse, labeled *Equus gmelini,* is, as Otto Antonius has elaborately and convincingly proved, almost the only ancestor of our domesticated horse. Since all living equines can cross-breed, some other strains may have come in on occasion, but the main stock was this now extinct animal. Like the Przhevalski horse, it was forced toward the East in the course of human history, or rather it lasted longest in the thinly settled East of Europe. The last known specimen of this wild horse, known as *Tarpan* to the

[1] Often spelled Przevalski. The pronunciation *Pshe-vall-skee* comes close to the customary pronunciation by Russians of that originally Polish name.

Ukrainians, was a mare which was accidentally killed at Christmastime 1879.

Just when it disappeared from Europe proper is unknown.

It is clear that real wild horses had still lived in Europe at the time of the Roman Empire and even later. The *Nibelungenlied's* mention of the "grim *Scelch*" slain by Siegfried is proof of that, but it may also be taken as proof that it was a rare event. Some German zoologists believe that it lasted longest in southern Germany, and they offer as proof a somewhat strange Bavarian term, of the more abusive variety. In doing so they are careful to point out that abusive terms are often old. The word in question is this: all over northern Europe the donkey is used as a symbol of stupidity, but while the Prussian calls a stupid neighbor *Esel* (donkey), the Bavarian is apt to call him *Waldesel* (forest donkey). Where the term *Waldesel* is customary, the ordinary donkey, which had been introduced to Germany from Italy, is called *Steinesel* (rock donkey). The belief is that *Waldesel* represents a memory of the gray forest horse.

Well, they may be right.

The death of the last mouse-gray wild horse fortunately took place in the neighborhood of a family of record-writing landowners, the family von Falz-Fein. This family owned a very large homestead in the Ukraine, straight North of the Crimea, which they called *Ascania nova.*[1]

"My father," one of the Falz-Feins reported later, "was a horse expert and breeder of fine horses and was especially interested in the wild horses, which in his younger years were still fairly frequent in the Ukrainian steppes, without ever crossing over into the Crimea as far as is known. In the early seventies he often told me, when returning from a trip, that he had seen a small herd of wild horses in the steppes. In the end he saw only eight, then five and finally two horses, always in about the same locality. When he spoke of them for the last time he said: 'Today I was where they are building the railroad (from Kharkov to Sevastopol) and I saw two wild horses in the steppe.' Several years later he mentioned a single wild horse once

[1] This also became the title of a book in which the history of that homestead is described.

more, which he had seen in the section known as the Rachmanoff Steppe."

Falz-Fein's report then switches over to the story which he had been told by a neighbor, the landowner Aleksandr Durilin, who lived not far from the village of Lepetisha. He had rented the Rachmanoff Steppe, or rather a part of it, some one hundred thousand acres, of which he was permitted to use some four thousand acres as arable land. The remainder had to be left as it was, according to the contract, but could be used for grazing. There Durilin kept a herd of horses of the customary domestic variety of his time and place. They were kept as a *Tabun,* which means that they were left to graze in the open, near a lonely stable, supervised only by a mounted herdsman or two who would provide some hay during the coldest time of winter. Quoting from Falz-Fein again:

> The last wild horse, a mare, joined this herd for company. When the herdsmen were away, she was somewhere among the others. But as soon as a herdsman appeared, she separated, standing waiting at some distance. The men never saw this animal lie down for a rest, while the domesticated horses usually spent some time of the day lying down. About three years passed, than the wild mare slowly became somewhat more tame. She did not run away very far any more when the herdsmen came and even stayed close when the herd was driven to water or winter feed. During these three years she foaled twice, the colts being sired by a tame stallion of the Durilin herd. One of them looked like its sire, the other very much like the wild mare. Both colts were taken away, brought up away from their mother and used as work horses; but they were small and poor workers. . . .

After three years the wild mare followed the herd into the stall for winter feeding, Durilin used the opportunity to isolate her by letting the domesticated horses out one by one and keeping the *Tarpan* inside. She was struggling madly and lost one eye in the process. Kept in the stall, it gradually developed that a certain amount of handling was possible. The mare could be led to the water, but always made at least one attempt to break away. She took hay from the keeper, but permitted no touching and there was no possibility of currying her. After the mare foaled a third time, inside the stall, Durilin was convinced that she would stay with the herd, but as soon as the door was opened she broke loose. After a short time she returned, sep-

arated her youngest from the other horses, and disappeared with it.

A few days later, in 1879, the Falz-Feins were told about a wild horse which had been seen some thirty-five *verst* (about twenty miles) from Ascania nova, near the village of Agaimany. It was winter and the peasants decided to test the fleetness of their own horses by chasing the wild one. They did that during the Christmas holidays. They established a number of outposts, each manned by the best riders on their best horses, and the men of each outpost chased the wild mare to the next one. The domesticated horses grew weary, the wild one did not, and would have escaped if it had not caught one front leg in a hollow in the ground. Unable to move, it was loaded on a sled and brought to Agaimany. Everybody saw with great surprise that it was a one-eyed old mare, the same that had foaled repeatedly in Durilin's stable.

The peasants had no idea that they were dealing with a great rarity, but they did decide to try to save its life. The village barber did his best and the Falz-Feins learned that he tried to make an "artificial hoof." Unfortunately the report is not too clear at this point, it sounds as if the barber had amputated the lower part of the broken leg, knowing that the break would not heal. But the old mare did not survive the long chase and the injury. She died between Christmas and New Year's Day. Since this was Russian style, the last gray wild horse of which we know found its end during the first days of January of 1880.

Since Russia is large, one could hope that some other wild horses might have survived in other sections of Southern Russia, and Russian journals, professional and otherwise, were eagerly scanned for a chance report on wild horses. It was just possible that somebody might have seen some and written an article about them without quite knowing what he was really writing about. But the search was fruitless.

Interest then centered for a while on the so-called "wild horses" of Lippe-Detmold in Germany. What had happened there is that the family of a German nobleman had had the habit of letting a large number of horses run wild for centuries, nobody interfered with them except for a yearly round-up in which the new generation was

branded. In the course of time that yearly round-up developed into a kind of local festival which survived the First World War, lasted through the German Republic, and even through the early years of the Hitler regime. Zoologists knew well, of course, that these horses were "feral" like those which the Indians had tamed. But a comparatively high percentage of them did resemble the extinct gray wild horse in color (some even had that black stripe running down their spine) and they were also rather small as a rule. The reasoning ran that these horses, while essentially feral, might still carry a relatively high percentage of "wild" blood, since the herd as a whole had been established at a time when wild horses were still possible in that area, even though there is no documentary mention of any.

In fact the brothers Heck, spurred by their success with "rebreeding" the urus, tried to "rebreed" the old wild horse too. They used a few typical specimens of the Lippe-Detmold stock and did obtain a few horses which at least looked very much like the old *Scelch*. But their reconstructions perished during the Second World War. Of course the experiment can be repeated and will probably lead to the same result.

But the only true wild horse which we can still see in the zoo is the Inner-Asiatic Przhevalski type. Which is a fine wild horse, but has little or nothing to do with the horse that pulls the milk wagon.

12: *The Saga of the Geirfugl*

THERE was a rough sea and a strong wind blowing during the night of June 4, 1844. The waves taxed even the hard muscles of the fishermen who manned the eight oars of the boat in which a party of fourteen men had set out from the southwestern corner of Iceland.

This was neither an ordinary fishing nor a pleasure trip. The leader of this overnight expedition, one Vilhjalmur Hakonârsson, had a very definite goal in mind: he and his Icelanders were to look for a certain large sea bird which they knew well. It was a rare bird—at least it had recently become rare—and because of its rarity people in Denmark and in other European countries were willing to pay a high price for its skin. Carl Siemsen of Rejkjavik, the capital, acted as agent for these people, and he was offering an unheard-of price, an even hundred crowns, for each dead bird. Hunting it was a bit dangerous, and right now it was probably nonsense because there seemed to be none left, but a hundred crowns was a fortune, and at worst they would have toiled for nothing for one night and would have got drenched by breakers and by the surf—these things were part of a fisherman's life. Siemsen seemed to be pretty certain that there were such birds around on Meelsaecken. Meelsaecken—"the flour bag"—was the term Carl Siemsen used for a rocky island not too far from Cape Reykjanes; its real name was Eldey.

The bird they were after was the *geirfugl*. The English called it the garefowl, or the great auk. Vilhjalmur Hakonârsson regretted that the offer had not come a dozen years or so earlier; there had

been another island then, Geirfuglasker (Geirfugl Skerry), where these birds had been really numerous. But no one had offered such prices for their skins then. But Geirfuglasker did not exist any more; that was why the geirfugl now lived on Eldey.

There was little question of where to look for the great auks once Eldey was reached. They were heavy, large birds, standing about

Geirfugl or great auk

(Drawing by Gustav Wolf)

three feet tall. They could not climb vertical cliffs and, though excellent swimmers, they could not fly at all. In short, they could go only where men could go too, and if their way to the water was blocked they could not escape. Their large, strong beaks were a poor match for a strong man with a stout stick. So, since there was only

one place on Eldey where men could go without the aid of ropes and ladders, Hakonârsson directed his boat to that point. It was reached just when a gray dawnlight illuminated the gray, angry water and gray rocks. The surf pounding the coast of Eldey was bad enough to scare even these fishermen. Only three of them dared to jump ashore. Their names are recorded; their fame has much of the flavor of that of Bartmoleus Szpakowicz, he who killed Europe's last wild wisent. They were Sigurdr Islefsson, Ketil Kentilsson, and Jon Brandsson.

They had to climb up to a rocky ledge. All kinds of sea birds were flying around them, but there was no mistaking the two dark-colored, upright, three-foot birds with their large beaks and tiny wings. The two birds sensed the danger but they were helpless. Their attackers came from the sea and behind them the rock rose vertically, unscalable for great auk and man alike. Jon Brandsson caught one of the two birds near the vertical wall; Sigurdr Islefsson got the other at the edge of the ledge. The third man, Ketil Kentilsson, looked for another victim, saw none, and went back to the place where the two birds had first been sighted. Geirfugl eggs had market value too. There was a large egg on the spot, but it was cracked and Ketil Kentilsson threw it away, deeply disappointed.

Later scientists recorded that one morning between June 2 and June 5, 1844, probably at dawn of June 4, the last two great auks were killed on Eldey by Jon Brandsson and Sigurdr Islefsson, two Icelandic fishermen.

The bird that became extinct that morning had not always been a rare bird for man. At about the time when the first civilization began to develop in the Nile valley, the great auk had lived along all the important shores of the Old and New Worlds. Its habitat had reached from the northern tip of the coast of Norway down to the southern tip of the Swedish coast in the Baltic Sea; it had stretched from the German coast opposite the southern tip of Sweden all along the Danish, German, Dutch, and French coastline at the North Sea, extending southward along the French Atlantic coast to the northern coast of Spain and west to Cape Finisterre. These birds had surrounded England and Eire, all of Iceland, and the southern parts of

Greenland, from Cape Dan on Greenland's east coast around its southern end and northward on the west coast to Disko Bay and Disko Island. In America the great auk had lived from Labrador and Newfoundland down to the Atlantic shore of Florida. Our knowledge of this immense habitat is based on two kinds of evidence—on reports of early travelers and on finds of the remains of the great auk.

Denmark, for example, is very famous in archeological circles because of the immense prehistoric garbage dumps left by otherwise forgotten inhabitants of that country. These *kjökkenmöddinger* ("kitchen-middens" is the English equivalent) consist mainly of oyster shells, mixed with bones of animals and birds. In 1855 Professor Japetus Steenstrup announced that he had recognized some of the bird bones as belonging to the great auk. And, indeed, the great auk is mentioned in the ancient Norse Edda. The word *geir* means "sharp" or "pointed" or, even better, "spear-shaped," probably an allusion to the strong bill of the bird. *Geirfugl,* therefore, may be translated as the "spear bird," a translation that sounds somewhat incongruous if the shape of the whole bird is thought of instead of the shape of its bill.

The geirfugl, when fully grown, stood about three feet tall and had the coloration and the general appearance of a penguin. There was an important difference, however, in the shape of the wings, not to mention the very characteristic large beak. The wings of the penguin have assumed the function and the shape of flippers. The wings of the great auk were just as tiny as those of the penguin, but, though weak and useless and small out of all proportion to the body, they still looked like bird's wings. The great auk laid only one egg per season, extraordinarily large even for this large bird and beautifully colored and spotted. The birds must have been long-lived to multiply to such numbers as inhabited these many shores, with only one egg each year.

The names geirfugl, garefowl, and great auk do not complete the list of appellations under which the bird was known. There was another and very important name given to it by some Celtic-speaking peoples, the name *penguin*. This hitherto mysterious word has been

satisfactorily explained as a derivation from the Welch words *pen* (head) and *gwyn* (white). Now the head of the great auk was dark brown, almost black, but this dark color only emphasized the blinding white of two large spots on either side of the head. The name *penguin,* therefore, really applies to the geirfugl, with which European fishermen and seafarers were acquainted. Later, when the "penguins" of the Southern Hemisphere were discovered, the Celtic name was simply transferred to these birds. No doubt the two birds looked very similar in general appearance, and it is asking too much that the early explorers should have paid attention to such niceties as shape of bill and wings and anatomy in general.

Consequently many old reports speak of penguins in the north as well as in the south. If Nature herself had not drawn a sharp dividing line, it would be impossible nowadays to find out just what it was the old sea captains had in mind when they spoke of penguins. That dividing line is the Equator. Penguins—the birds to which *we* apply that term—live on the Southern Hemisphere only. Their northernmost representative, the Galapagos penguin, lives on the shores of the Galapagos Islands, just under the Equator. The great auk reached its "farthest south" in Florida, some distance from the Equator. It is, therefore, only necessary to know the locality to decide whether the real penguin or the geirfugl is referred to in old narrations.

The first scientist to distinguish sharply between northern and southern penguins was the aged Count de Buffon during the latter part of the eighteenth century. Buffon, reading Cook's and Forster's reports from the Southern Hemisphere, realized that the "penguins" there and the "penguins" in the north were by no means the same. They were not even related to each other, but happened only to bear a superficial resemblance in posture and color. They should have different names, therefore, and Buffon proposed to use the term *penguin* for the great auk only, and to establish a new name for the southern birds. He suggested that the latter be called *manchots,* but no attention was ever paid to this suggestion. As the name penguin became definitely accepted for the southern birds, the northern ones came to be called either great auks or by their Edda-name of geirfugl.

A few spots were famous as breeding grounds of the great auk. In Europe it was St. Kilda and the Fuglasker (Bird Skerries) near Iceland; in America it was a small island not far from Newfoundland. At the end of the fifteenth century the great auk also lived in great numbers in other places in the Western Hemisphere. Columbus's landings were always too far to the south for him to encounter the bird, but the Cabots told of them at length. Hans Egede, when he reached Greenland after his encounter with the sea serpent, was so impressed by the number of great auks that he called them "characteristic of the Greenland coast." At that time the geirfugl had apparently receded from the coast of continental Europe, though a few specimens may have appeared there occasionally. It also seems that the bird no longer lived south of the mouth of the Delaware River on the American shore.

But there were large numbers of geirfugl in America north of New York. In fact, sailors relied upon their presence for food. One Mr. Anthony Parkhurst wrote in November 1578 to Richard Hakluyt: "The Frenchmen that fish neer the Grand Baie doe bring small store of flesh with them, but victuall themselves with these birdes." There existed one special "penguin island" where the men went to "victuall themselves." It was not the same as the "Penguin Island" of Anatole France, and the men who went there were, in consequence, not especially holy. One of the earliest mentions of this soon famous "penguin island" (it was actually referred to by this name) can be found in *Hakluyt's Voyages* (Vol. III, London, 1600) where the "Voyage of M. Hore and divers other gentlemen to Newfoundland and Cape Breton in the yeere 1536" is printed:

> From the time of their setting out from Gravesend they were very long at sea, to witte, above two moneths, and never touched any land untill they came to part of the West Indies [North America] about Cape Briton, shaping their course thence northeastwards untill they came to the Island of Penguines, which is very full of rocks and stones, whereon they went and found it full of great foules, white and grey, and big as geese, and they saw infinite numbers of their eggs. They drave a great number of the foules into their boates upon their sayles, and took many of their egges, the foules they flead . . . and eate them and found them to be very good and nourishing meate.

If we may judge from the descriptions of these and later slaughterings, the great auks not only looked very much like penguins but behaved much in the same manner. When the men came to shore the tall upright birds were waiting for them like a reception committee, approaching them with a ludicrous mixture of curiosity and dignity. The men were curious too, but much less dignified. They had sticks in readiness and the geirfugl paid with their lives for their incautious trustfulness.

Since the great auk could not climb vertical walls the sailors often kept their meat alive by herding the birds into crude "corrals" built of stones. It almost seems as if the men actually liked the meat of the birds; at least the coarsened palates of the early sixteenth-century sailors did not rebel against this diet. Much later, a man who was not a sailor tasted geirfugl out of curiosity and reported—as might have been expected of a fish-eating bird—that its taste was "atrocious." That objection did not apply to the eggs; they certainly were good food and they were so large that one egg almost made a meal.

The number of great auks must have been tremendous. Jacques Cartier told in 1534 that his men killed more than a thousand "north-penguins" during a single day in one spot on the shore of the American mainland. But, he added, there were enough left alive to fill forty rowboats. Another captain reported that his sailors killed two boatloads of great auks within half an hour—with their bare hands!

A few skins were brought to Europe and kept in collections. For many years there was a great auk's skin in the museum of Strasbourg. It was the only American skin left, although that had occasionally been doubted for no very convincing reasons. It was, however, generally admitted to be the oldest geirfugl skin in existence; and if it was American, as is likely, it proved what travelers had always asserted: that there was no difference between the American and the European bird. This famous skin disappeared later. It is uncertain whether it was removed by the Germans some time during the First World War and brought to another place in Germany or whether the French took it to France just after the war.

Only two hundred years after the first colonization of North America, the great auk was very rare on the continent; fifty years later

it no longer existed. The bird disappeared so completely that even "penguin island" itself was forgotten. When in about 1820 the great American ornithologists Wilson and Lucien Bonaparte wrote the first important scientific works on American birds, they did not mention the great auk at all. Of course they knew the geirfugl, but to them it was not an American but a European, more specifically an Icelandic, bird.

In a way the great auk's fate in Europe was stranger and less known than its fate in America. In America there was at least someone to blame for the recession of the great auk; in Europe it receded without recorded mass-slaughterings and without even attracting attention. There are only the barest of facts available.

When Konrad Gesner wrote the book of birds in his great natural history, at just about the time that the great auks were being killed by the boatload on "penguin island," he did not mention this bird. The knowledge of its existence had not penetrated to Switzerland. The Swedish Linnaeus knew the geirfugl, of course. He gave it the name *Alca impennis* (wingless auk) and added: *habitat in mari Norvegico rarius*. It was rare then, even in these northern seas.

From the Faeroes the great auk was reported as "very rare" in 1673, but it could be found there occasionally even many years later. From St. Kilda, the westernmost island of the Hebrides, we have a report dated 1697, stating that the geirfugl came every year in May to lay its egg on the bare rock and to hatch its young. But in 1758 it was reported from the same locality that the great auk did not come regularly any more and that several years might go by between appearances.

In 1790 a lone great auk was caught in the harbor of Kiel in the Baltic. It was the last geirfugl in the entire Baltic and caused great astonishment. In 1800 the only habitat left to the bird was Iceland. A small rocky island at some distance from Iceland itself, apparently twice as far away as the present Fuglasker, became a new "Penguin Island," with all the implications of that name. It was the geirfugl's fate to have its name twice placed on the maps of man, once in the Eastern and once in the Western Hemisphere, and each time in a way reminiscent of the captain whose relatives learn that he was

stranded and died on an uncharted isle which now bears his name.

The "penguin island" near Iceland was Geirfuglasker, mentioned under that name for the first time in 1397 by one Wilchins Máldaga. Geirfuglasker became the chief hunting place of the Icelanders, in spite of notoriously heavy surf and consequent danger. The churches had a special tax on Geirfugl from Geirfuglasker. The church at Kyrkjevogr officially owned half of the bird skerry, which meant that half of the proceeds from any hunting trip to Geirfuglasker fell automatically to the church. The other church at Utskála taxed the remainder at fifty per cent, so that only one quarter of the original proceeds could be retained by the fishermen themselves. Small wonder that they tried their best to make each trip pay, especially since they were not only handicapped by truly excessive taxation but had to undergo considerable danger besides. In 1628 no less than twelve men were drowned there, and there were other years that claimed almost as high a toll.

The trips that "had to pay" caused a shortage of geirfugl around the middle of the seventeenth century. The result was that for seventy-five years no one cared to make the highly taxed, dangerous, and generally unprofitable trip to Geirfuglasker. A Danish author named Johann Anderson in 1746 published a book about Greenland and Iceland, in which he wrote that there had been astonishing numbers of great auks on Geirfuglasker in 1728, so many that only a supernatural explanation could account for their numbers. It was, concluded Anderson, most probably a mystic warning that King Frederick IV of Denmark was soon to die.

The Icelandic fishermen did not spend much time in wondering whether the new supply was supernatural or not; they went to Geirfuglasker to kill as many birds as they could. But they had learned something from experience and left the birds alone every other year. Then came the Napoleonic wars. In 1808 a ship landed near Geirfuglasker with the purpose of securing a large supply of fresh meat. This visit caused considerable damage, but the year 1813 was even worse. In that year the schooner *Färoe,* commanded by Captain Peter Hansen, was sent to Iceland especially for geirfugl. The soldiers slew the birds as they sat on their eggs and the eggs were collected by

the boatload. The hunters even had to leave many dead birds behind, because the sea became so rough that they could not land a second time. Still that did not eliminate the geirfugl in its last stronghold. In 1828 a specimen was brought from there to Copenhagen, proof that it still existed. But now Nature helped in the extermination in a most violent and thorough manner.

The sea bottom in the neighborhood of Iceland had long been known to be subject to erratic changes. Fishermen and sailors had told for many centuries that south of Cape Reykjanes tiny islets would appear and disappear, lasting sometimes for only a few weeks. Geirfuglasker was a large island as compared with the others and had lasted for many centuries. Its time came in March 1830.

During the first week of that month the whole island disappeared. No human being witnessed the catastrophe, but it must have been gradual enough to enable good swimmers to flee. In the following months the exceedingly rare great auk appeared in places where it had not been seen for centuries. A few were caught at the shore of Iceland; one, almost starved, was found near Ireland. The majority of the survivors fled to Eldey. Eldey had been unfit for the great auk before the catastrophe that submerged Geirfuglasker. Only flying birds had been able to live on Eldey. But the same catastrophe had caused a change on Eldey; it could now be climbed at one spot. Geirfugl climbed it and tried to keep their species alive.

The trouble now, however, was that around 1820 the collectors of bird skins, and the museums had begun to realize that the great auk was rare and that their collections lacked specimens. The dealers had only to trace the few specimens they had to their point of origin to learn that they had all come from Iceland. And in Iceland it was known that Eldey was the exact spot.

Consequently Eldey was raided. About twenty birds were collected in 1830, another twenty-four in 1831. In 1833 thirteen birds and one egg were secured; in 1834 nine birds and eight eggs. After a short pause, in 1840 four more birds and five or six eggs were delivered. Then the fishermen reported that there was none left. A few years later the offer of a hundred crowns for a fresh skin was made. And

in June 1844 Carl Siemsen finally persuaded Vilhjalmur Hakonârsson to try Eldey again. . . .

And Greenland, where Hans Egede had found geirfugl in abundance? No one knows. The fact is that none has ever been found up there since, although hope lasted long and many visitors to Greenland kept a sharp lookout. In America the last great auks were apparently killed between 1750 and 1800. It is true that the birds were mentioned later by American authors. The most famous among these statements is that of Audubon, who was told in 1838 that the bird was still breeding on small islands off the Labrador coast. Audubon had no time to visit those islands and it was probably a mistake.

But old "penguin island" was rediscovered. At first it was thought to be Fogo Island, but it was Funk Island, not far from Fogo. The Norwegian scientist Stuwitz was the rediscoverer. He not only found many bones of the great auk on Funk Island, he also found remains of the old stone enclosures where the bird had been kept for slaughter. Twenty years after Stuwitz, a firm started taking guano from Funk Island as commercial fertilizer. During this prosaic procedure more great auk bones were discovered and usually preserved. A few feet under the surface a few skinless mummies were found. They were sent to England and no less a man than Professor Richard Owen wrote the first monograph on the great auk from these mummies. It appeared in 1865, exactly twenty-one years after the extinction of the last living specimens.

Since then Funk Island has been visited again and again. John Milne had only one hour's time when he landed there in 1874. During the first half-hour of his search he was unsuccessful, but during the remaining half-hour he collected many bones belonging to no less than fifty individuals. Lucas and Palmer in one day in 1887 collected bones from seven hundred individuals, and later searches were also fairly successful. These Funk Island finds resulted in a number of skeletons for museums.

In 1885 an inventory was taken by Symington Grieve. He counted 79 or 81 (depending on one uncertain report) skins in museums and

private collections, two dozen complete skeletons, two bodies preserved in alcohol, and about 75 eggs. This list does not include the skeletons assembled from bones dug up on "Penguin Island." All eggs and all skins, with the exception of the now missing skin of Strasbourg, are of European origin (even those now in America); the majority of them came from Eldey during that last period. About a dozen skins came from Geirfuglasker, the remainder from those specimens which were scattered over the North Atlantic by the catastrophe of 1831.

Fate provided a final triumph for the geirfugl, long after its extinction. The few skins which had been secured during a single decade (1832–1842) became valuable, so valuable that they were paid for not merely with their weight in gold but much higher. The last years before the First World War brought prices ranging from $12,000 to $20,000, and since then geirfugl can no longer be bought at all; those who own specimens will not part with them. However, since the skins were so valuable, skillful taxidermists set out to fake them. The museum in Darmstadt, Germany, for many years prided itself on the possession of a stuffed great auk. One day someone had the idea of examining it with utmost care and thoroughness. He found that it consisted of feathers of various small and by no means rare varieties of auks put together to make a great auk. Only the skull was genuine; it had come from Funk Island. The disappointment was great, but the whole case proved how rare and valuable the great auk really was. It had attained the highest triumph of fame, the flattery of being imitated.

The American Museum of Natural History in New York City is proud to possess and to display a genuine skin of a great auk. But one day I heard a passer-by remark: "It's a penguin." That remark was almost correct. It is not *a,* but *the,* penguin, the original *pengwyn,* the first bird to bear this name.

13: The Curious Case of the Giant Sloth

ZOOLOGICAL mysteries absolutely refuse to recognize borders, be they political, linguistic, or even geographical. They loom up out of the icy waters of the Greenland coast, they can be found on the bird skerries of Iceland as well as in the valleys of the Alps, in the Russian steppes, and in the sweltering greenish twilight of the Rainy Forest of Central Africa.

The one we are going to survey next had its origin at the extreme southwest coast of South America. More specifically, it originated near a fjord or inlet—locally called a "canal"—near the southern tip of Patagonia.

That so-called "canal" bore the gloomy name of Ultima Esperanza (Last Hope) but that did not prevent a retired German sea captain by the name of Eberhard from buying a ranch near it and building a house on the ranch. Visitors to the Eberhard ranch, when shown around, could notice a hide of some animal hanging from the bushes which defined the boundary of the ranch at one point. Most of them probably did not pay too much attention to it—neither did Captain Eberhard himself—but many vaguely have assumed that it was a cow hide, or possibly a horse hide, going by size only.

But some—or so it was told later—tried to cut a piece of that hide as a souvenir of their visit to the Eberhard ranch. If some did, they must have noticed that it was not the hide of a cow, or a horse or a llama or any other large animal one might expect to find in South

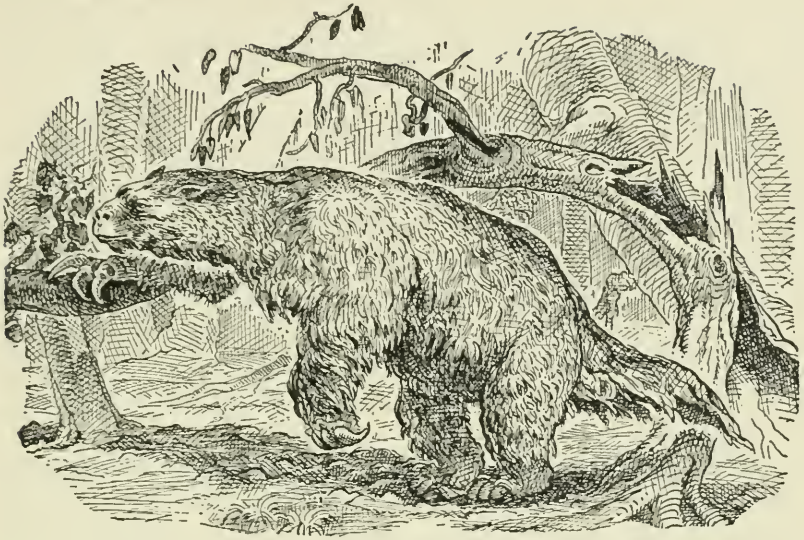
America. They also must have struggled hard, for to cut a piece from that hide required a sharp knife and strong hands.

One day a piece of hide—exactly this same kind of hide, though possibly not from Ultima Esperanza—happened to fall into the hands of a professional zoologist, Professor Florentino Ameghino. Ameghino was one of those rare men who conserve their youthful enthusiasm and imagination all through life. Professor Ameghino, as a matter of fact, was not long puzzled by the piece of hide; he soon had a fairly good idea what it was. But that piece of skin was fresh! Not exactly bloody, but not very old either—say about three or four or maybe a dozen years old. And it should by rights have been at least three or four thousand years old; for it was, incredibly, from the hide of one of South America's most famous early inhabitants—the giant sloth.

Professor Ameghino worked himself, the mails, and the cable companies into a multilingual frenzy. *The giant sloth still alive! El mamifero misterioso no se ha extinguido! Le mégathère: un animal d'aujourdhui! Das Riesenfaultier ist nicht ausgestorben!* Too bad nothing ever came of all this. *El mamifero misterioso* is still a mysterious mammal. The story came to no conclusion; it simply petered out. Yet it remains one of the most interesting of animal mysteries.

The first skeleton of *Megatherium,* or the giant sloth—it happened to be of the largest variety, which grew to almost the dimensions of an elephant—was found in the Argentine in 1789. The gigantic bones came to light in the loam of the banks of the Luyan River, not far from Buenos Aires. The Marques de Loreto was Vice-Regent at that time, and he saw to it that the bones were sent to the Royal Museum in Madrid, where José Garriga undertook the task of preparing, assembling, and making a scientific description of them. It took a few years to finish the job.

Meanwhile a French diplomat visited Garriga and sent a preliminary copy of the description to Cuvier, who lectured about the animal at the next meeting of the Academy. He gave it the name *Megatherium americanum*—combining the Greek *therium* (mammal) with *megalos* (large)—a name that was later changed to *Megatherium giganteum.* (Philologists have remarked on occasion that



Fossil *Mylodon:* one of the varieties of extinct giant sloths
(Drawing by Gustav Wolf)

they do not approve of such a name: in the first place it should be *Megalotherium,* and in the second place it is overly descriptive or redundant, since *megalos* does not differ sufficiently in meaning from *giganteus.*) Garriga's description appeared in print in 1796 and raised a storm of interest. It was then that Goethe wrote an essay on *Megatherium* that has been termed a "preliminary treatise on evolution."

One by one other varieties of giant sloths were discovered, among them a somewhat smaller (but still gigantic) kind which received the name of *Mylodon.*

The South American peons had their own ideas about these gigantic bones. Strangely enough, they evolved exactly the same legend as that of the Siberian tribes about their mammoth finds. The Siberians could not, of course, imagine that the fresh cadavers of gigantic hairy elephants that they found thawing out of glaciers had been frozen for the better part of thirty thousand years. And so they believed that the mammoth was a gigantic mole, which lived and burrowed underground, and died when it came up by mistake and got

into the warm rays of the sun. For the South Americans, too, the giant sloth was an underground mole that had died when it was exposed to sunlight.

Though the scientists knew that the giant sloths had once lived above ground and had died natural deaths, they were far from agreed as to when the animal had lived. It was certain that it was of a comparatively recent period, the period of its glory falling somewhere between the time of the great saurians and the ascendancy of man. Scientists believe that man came to America from Asia via the Bering Sea and spread from there southward. That earliest immigration is customarily dated as having taken place around the year 25,000 B.C.; and at that time, it was said, *Megatherium* was already extinct.

Or was it?

One school of thought, led by the German professor Hermann Burmeister, who had made his home in South America solely on account of *Megatherium,* answered affirmatively. Burmeister himself never tired of explaining to visitors that primitive man and the giant sloth could never have met. This attitude, which for a while was the more generally accepted one by men of science, shows another amusing parallel to the history of the European woolly mammoth. About this big, long-haired elephant with long curved tusks, there had also been a controversy concerning the time of its extinction; and those who followed Cuvier's theory of cataclysms insisted that, since the mammoth belonged to a period prior to that of man, these two could never have been contemporaries. This conclusion was widely believed even after Cuvier's cataclysms had been discredited. Then, in the Vézère Valley in France there was found in a cave a picture of a mammoth made by early man.

That seemed to settle the question for the majority of scientists, but there arose a defender of the "old faith," in the person of the Danish professor Japetus Steenstrup of geirfugl fame. Steenstrup remembered the mammoth cadavers that had been found frozen in Siberian glaciers, and on the thawed flesh of which the dogs had fed voraciously, as no doubt also did the natives. Such finds, thought Professor Steenstrup, might explain not only the cave drawings but also the mammoth bones that had been found, fire-blackened and

split open for their marrow, in the camp sites of ancient man. The models of the artists and the food of the hunters had been simply frozen meat found in the glaciers of the Ice Age, the professor insisted. But then geologists proved quite conclusively that there had never been glaciers of any considerable size or duration near Předmost, in Bohemia, where a great pile of neatly sorted mammoth bones had been discovered. And elsewhere mammoth bones were found with spearheads still imbedded in them. Then the scientific party led by Steenstrup quietly dissolved completely away.

Almost the same thing happened to Professor Burmeister's followers. Remains of another spectacular animal, a giant armadillo—called *Glyptodon*—furnished the first clues. *Glyptodon* had lived at the same time as *Megatherium;* so much was universally admitted. But the mighty carapaces of *Glyptodon* were often found together with human implements; and once a human skeleton was discovered sitting inside a *Glyptodon* carapace—undoubtedly an ancient form of burial. Then *Megatherium* bones were found, blackened by fire, split open, showing the marks of tools. No pictures—apparently the ancient South Americans had less artistic talent than the primitive Europeans. Finally a skeleton of *Megatherium* was unearthed that was incomplete in a remarkable manner. All four legs were entire and undisturbed, but most of the other bones were missing or destroyed, and there had been a fire in the center between the four legs. Obviously a giant sloth caught in a pit and roasted right in the trap from above.

That the early South Americans had seen *Megatherium* "in the flesh" thus became an established fact. The next question was, of course: when had this happened? The experts were remarkably uncertain in their judgment; two thousand years ago was as good a guess as ten thousand.

It was at this point that Professor Ameghino appeared with an even more radical hypothesis. Any number of years ago, he declared, was as good a guess as any other number, depending only on the locality in question, for it seemed to him evident that somewhere *Megatherium* was still alive. It remained only to find it.

A story told by Ramón Lista, for a time governor of Santa Cruz

in Argentina—he was later assassinated by political opponents—suddenly became very important. Ramón Lista had related that one night, in the interior of Patagonia, he and his party had seen a large animal which reminded him of a gigantic armadillo, except that it was covered with long hair. It ran away and escaped, although they fired at it with their hunting rifles.

Professor Ameghino needed no more. The kind of giant sloth he suspected to be surviving—to judge from the piece of hide in his possession—was *Mylodon,* somewhat smaller than *Megatherium.* He named it *Neomylodon listai* (Lista's new mylodon) in honor of the governor who had had to stand so much ridicule about his "terrestrial sea serpent." Why the bullets from the hunting rifles had not harmed the animal, Professor Ameghino could easily explain. *Mylodon* was armored, not only with a thick coat of long hair, but also with small bony growths imbedded in the thick hide. It was these small "skin bones," about the size of beans and closely spaced, that had made it so difficult to cut a souvenir from the hide at Ultima Esperanza.

At this juncture it was remembered that Indios had been telling about a nocturnal animal the size of an ox which lived in the Pampas, sleeping during the day in burrows it dug with its large claws. The animal was harmless, they said; but it could not be killed, for no arrow would penetrate its hide. The Indios had a name for this animal: *iemish* they called it, which is said to mean: "The one with little stones on it." A beautiful description of *Neomylodon listai,* said Ameghino.

In the meantime the hide from Ultima Esperanza had been traced back to its place of origin. The excited investigators learned that it had been found in a natural cave not far from Captain Eberhard's ranch. The cave—it is still known as the Eberhard Cave—was explored as soon as this could be managed. More remains were found; there was no doubt that numerous members of the *Mylodon* tribe had once lived there. Low and primitive but sturdy walls of rough stone were found to subdivide the cave. It almost looked as if the animals had been stabled there; and Professor Roth, another expert, did not hesitate to embody this thought in the name he gave to the variety

of giant sloth whose remains were discovered—*Grypotherium domesticum,* the "domesticated griffin mammal."

Again it was impossible to establish a precise date. Some experts claimed that the remains were only a hundred or maybe two hundred years old, while others were willing to concede up to eight hundred or a thousand years. A hunt in the libraries also disclosed proofs that the animal had still been alive after the discovery of America. The Portuguese historian Lozano had mentioned in 1740 that there existed in South America a large animal that was remarkable in that it carried its young about with it. The natives hunted it, Lozano said, to make cloaks or capes of its hide. In appearance it resembled the anteater, and its name was *succarath* or *su.*

This *su* had already appeared in print about 180 years before Lozano in Konrad Gesner's *Historia Animalium,* in a short reference which reads:

> The Most Obnoxious Animal that might be seen, called Su in the New Lands. There is a place in the newly found land where lives a people calling itself in its language *Patagones,* and since the land is not very warm they cover themselves with fur from an animal they call Su, which means Water, by reason of its dwelling mainly near water. It is very dreadful, obnoxious, as may be seen [but the picture, which shows a distorted human head, is plainly a mere artist's fancy]. When hunted by the hunters it takes its young upon its back, covers them with its long tail and thus flees; will be caught in pits and killed with arrows.

When all this was known, it seemed obvious that a great discovery was simply waiting to be made. Only one little item was still missing to make the story complete: the animal itself. And a London newspaper, feeling that it should not be too difficult to find this evidence, financed an expedition. It was a glorious failure. So much so, that the leader of the expedition, Mr. H. H. Prichard, discounted everything, from the *su* to the *iemish.* He even denied the existence of the legend.

After that the hunt for the living giant sloth gradually died down. But it did not die out, not completely at any rate. Every once in a while there will appear a story to the effect that fresh remains of *Grypotherium* or of a closely related variety have been found some-

where, remains that look as if they are hardly more than a hundred years old. No one, however, has had an experience comparable to that of Ramón Lista; nor has anyone tried to perpetrate a hoax of this kind. No doubt, if someone should, we would very likely hear that the animal encountered looked like a sloth the size of an ox, but was able to move fairly fast on the ground, which is something tree sloths cannot do. Ramón Lista's story is actually more convincing than such a tale would be, for the name giant sloth is somewhat misleading; *Megatherium* and the various *Mylodons* were not simply overgrown sloths.

A recipe for their reconstruction would have to read as follows: Take living sloths, several pairs of them, a few giant anteaters, and a number of armadillos; mix well; add some general sturdiness throughout; pour the whole into a mold for one large animal; and the result will approximate a giant sloth. If the giant anteater had not adapted itself to so monotonously exclusive an insect diet (with resulting changes in anatomy, habits, and appearance) it might have borne a closer resemblance to the giant sloth than any other living animal. But despite complete skeletons and many pieces of hide and fur, we are not quite certain how the giant sloth looked. We do know that it was a strict plant-eater, feeding on small plants and shrubbery as well as on the leaves of trees, if the trees were small enough to be broken down. We do know, too, that it must have preferred caves to live in; at least the number of remains discovered in caves is extraordinarily high.

There are two features about which we would like more information. One of them is how it walked. All the reconstructions in museums show it in a half-erect position, usually in the act of reaching for low tree branches. That the skeletons were usually mounted in this way indicates that they easily lent themselves to such a position. Fossilized giant sloth tracks near Carson City, Nevada—at the time of glaciation these animals were abundant also in the southwestern states—show only a single pair of footprints. This may mean either that they did walk erect or that the hind feet were put on the ground exactly in the same place as the forefeet. Since the greater weight rested on the hind legs—there is no disagreement about that—the

second print could completely obliterate the first. This question is still undecided.

The other question has to do with the color of the fur. The two modern varieties of small tree sloths both show yellowish-brownish hair. But this is true only of dead specimens in museums and of living ones in zoological parks far from their homeland. In their natural habitat sloths are decidedly green, and for a curious reason. A South American tree sloth lives what can only be termed a paradisaic life. Its food is tree leaves and its home is the trees of the largest forest on earth. The sloth might be said to swim in an immense ocean of food—an ocean that does not even thin with the seasons, because there are no seasons which affect it. The climate is always the same in the tree tops where the sloth is born, lives, and dies without ever coming to the ground, unless accidentally and much against its will. Under such warm, humid conditions tiny green algae thrive, and this microscopic plant life attaches itself to the fur of the sloth, giving the latter its characteristic green color. Incidentally, to make the picture a little more fantastic, these algae (each of the two varieties of sloths has its distinct variety of algae) provide food for the caterpillars of a species of small moth which has also taken up its abode in the thick fur of the sloth; and if a sloth happens to fall from its tree at a time when the moths are ready to leave the chrysalis, the impact with the ground is likely to release an explosion of winged insects.

That the algae have had time to develop into two distinct varieties proves that this living together of plant and animal has been going on for a long time. Did the giant sloths also, scientists wondered, have algae in their pelts? Finally, in a cave near El Paso, Texas, a specimen of *Nothrotherium,* one of the various giant sloths, was found. The dry air in the cave had preserved the cadaver so well that some parts of the skin and fur were as good as those of a poor museum specimen. The microscope revealed dried plant cells clinging to the hairs of the fur. In all probability—it is not absolutely certain—these cells were algae, and *Nothrotherium* was green.

One more question: Was the *Grypotherium domesticum* found in stone enclosures in the Eberhard Cave actually domesticated by the

Indians a few centuries ago? If so, why did it die out, since domesticated animals are apt to survive as long as the domesticator? But, of course, *Grypotherium* was not domesticated. What probably happened was that some Indians surprised a number of animals in the cave and hastily erected stone walls, so that the big beasts could be killed one at a time and a supply of fresh meat be assured over a long period. The indications are that this procedure was repeated several times in the same place—the giant sloths were evidently not very bright—and it is likely that this happened in other places too.

It is now the general consensus of experts that the giant ground sloth—as the many varieties of extinct giant sloths are termed—at least the variety *Mylodon,* was still alive a few hundred years ago. Some scientists think the extinction took place about eight hundred years ago; others are inclined to admit that isolated specimens may still have endured until three or four centuries ago. This would bring the giant sloth to the lifetime of Konrad Gesner and the early white explorers of South America; and it would, therefore, be counted among those animals that became extinct in historic times.

It might be argued—and it has been argued at length—that there is no climatic or other reason why the giant sloth should have vanished during those last three or four or even eight hundred years. Those who argue thus are hoping, of course, that the animal may still be found alive. And nothing actually speaks against this argument except the one fact that no giant sloth has ever been discovered.

14: As Dead as the Dodo

IN THE summer preceding the First World War a Dutch professor of zoology and his wife made a little vacation trip to the cities situated on the Island of Walcheren at the mouth of the Schelde River in the Netherlands. The professor was Dr. A. C. Oudemans, our old friend from the sea serpent chapter. But the trip had nothing to do with sea serpents and not even with zoology. Professor and Mrs. Oudemans were simply vacationing and looking over some of the famous old houses and historical sites on Walcheren.

Among these old houses there was one of which I carelessly wrote in the first edition of this book that it was situated "near Middelburg." Actually it was situated at Veere, another town on Walcheren. My slip would probably have passed unnoticed if it had not been for Hendrik Willem van Loon, who happened to be from Veere. Immediately, it seems to me, he sat down and dashed off a handwritten letter, partly in English and partly in German. In the first paragraph he wrote me that such a slip was so contemptible that he felt inclined to think that I was a Nazi spy. In the second paragraph he took that back, since a Nazi spy would know the difference between Veere and Middelburg. And in the third paragraph he informed me that Veere cannot and could not be considered to be "near Middelburg" because "those of Middleburg were still living in trees when we of Veere were living in *stone* houses."

At any event, there was a house at *Veere* which was known as the "Ostrich House." It had the name because it was adorned with a

stone bas-relief of a large and fairly long-legged bird and the inscription:

IN DEN STRUYS, 1561.
(To the Ostrich, 1561)

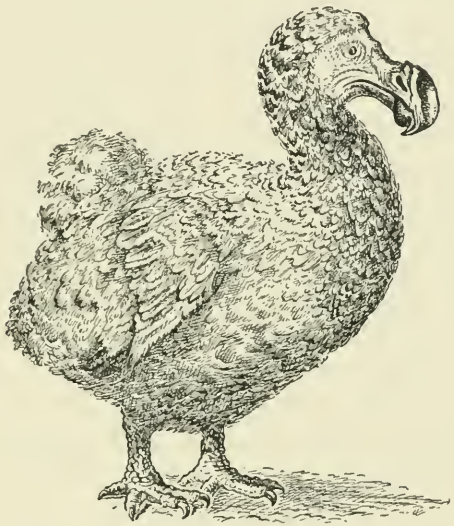
The house and its bas-relief had been described and pictured many times, but apparently they had never been scrutinized by a professor of zoology. When Dr. Oudemans saw the picture of an ostrich, and such an old one, the expert in him was awakening out of his vacation mood. Had the ostrich been known at all in the Netherlands in 1561? Yes, probably, for Konrad Gesner's long chapter on the ostrich had appeared in 1555. Gesner's book even contained a full-page woodcut of the ostrich, wrong as far as plumage was concerned, but essentially correct in outline. But that was more than could be said of this picture on the Ostrich House. It was anything but correct in outline. The neck was too short and so were the legs. The head was wrong and the feet had four toes, whereas ostrichlike birds have three at most.

And then, very suddenly, Professor Oudemans experienced the thrill that would befall a stamp collector who is doing somebody the favor of looking over his poor and uninteresting collection and comes across a genuine Mauritius, the most widely known of rare postage stamps, and a Mauritius, to boot, the existence of which was not known to philatelists and not even suspected. For Professor Oudemans suddenly realized that the stone carving portrayed a dodo, the extinct bird the name of which has become synonymous in English for all that is extinct. Now there were about a dozen dodo pictures known, each of them carefully catalogued as to artist, date, state of preservation, and location, but the existence of this picture had not even been suspected. And as if to make more striking the analogy with the emotions experienced by a philatelist, the home of the extinct dodo was the island of Mauritius.

There existed a small library of treatises on the dodo, written by zoologists of half a dozen countries, from Portugal to Russia, and Strickland and Melville had written one of those ponderous and exhaustive zoological monographs about it. The life and death of the dodo has been a perennially fascinating theme, although in terms of

time it is rather short. The bird and record-writing humanity walked the earth together for barely two centuries and during the first of these two no records were written.

That two-hundred-year period during which the dodo waddled into human ken began in 1505 with the discovery of two sizable islands east of Madagascar, under about 11° Southern Latitude. The discoverer was a Portuguese captain, Pedro Mascarenhas, and the islands,



Dodo

(Drawing by Gustav Wolf)

as a group, are still called the Mascarene Islands. Individually each has changed names more often than any other island in history.

Mascarenhas himself called the larger island Ilha de Cerné, and it was regarded as Portuguese for almost a century, although no settlement was established. In 1598 the Dutch came under Admiral Jaacob van Neck and renamed it *Mauritius,* after Count Maurits of Nassau. But the Dutch settlers and sailors referred to it as *Zwaaneiland* (Swan Island) because of the dodos. Then the island became French and

finally British. The French called it *Ile de France,* and the British restored Mauritius.

The other island was first named after its discoverer (but there exists the possibility that it might be identical with an island *Santa Apollonia* discovered a few years earlier by Diego Pereira), became *Ile de Bourbon* in 1632, *Réunion* in 1793, *Ile de Bonaparte* in 1809, again *Ile de Bourbon* in 1814, and, at long last, again *Réunion* in 1848.

A third island, lying east of Mauritius, was discovered in 1545 and is now known as Rodriguez, after having changed hands and names a few times in history like the others.

These three, Mauritius, Réunion, and Rodriguez, were the islands of the dodolike birds.

The Portuguese are said to have originated the name dodo, and there is a suspicion that the word is just an imitation of the bird's call. It is also said that the pronunciation, in order to imitate the bird's call, should be doo-doo. Well, maybe so, but it seems pretty difficult to decide such a question now after several centuries. Later on the Dutch came to refer to the bird as *Dronte* (which term is used in German too, alongside with dodo) and as for *Dronte,* everybody is frank in admitting that its meaning, if any, is not known.

But in the first report on the dodo which we have neither of these names is used. Instead Admiral van Neck employed a term which is no compliment. He wrote:

> Blue parrots are very numerous there (on Mauritius) as well as other birds; among which are a kind, conspicuous for their size, larger than our swans, with huge heads only half covered with skin as if clothed with a hood. These birds lack wings, in the place of which three or four blackish feathers protrude. The tail consists of a few soft incurved feathers which are ash-colored. These we used to call *Walghvogels,* [literally: "nauseating birds"] for the reason that the more and the longer they were cooked the less soft and more insipid eating they became. Nevertheless their belly and breast were of a pleasant flavor and easily masticated.

The dodos could not fly, but they were not completely defenseless. Admiral Pieter Willem Verhoeven, a witness (or victim), reported that the big bill "could bite damned hard." The birds were also hardy, they not only survived the long voyage to Europe but also lived in

captivity for many years after. The first dodo of which we have a definite record was brought back by Admiral van Neck himself when he returned to Holland in July 1599.

The painters seemed to have rejoiced: it was something new to put on canvas. Admiral van Neck's dodo was painted first in 1601 by de Bry. Between 1626 and 1628 it was painted no less than eight times by Roelandt Savery of Courtrai. Once it was painted by Pieter Holsteyn (undated). Other dodo paintings were made by Hufnagel (1626) and by C. R. Ruthardt (1666). There also exists a painting of the Creation, ascribed to Franz Franken, showing a dodo among the other birds. All told, there exist fourteen dodo portraits from that period.

Another live dodo was brought to Europe in 1638. This specimen has a very interesting history. At first, when still alive, it was exhibited in London, where Sir Hamon L'Estrange reports having seen it:

> About 1638, as I walked London streets, I saw the picture of a strange fowle hong out upon a cloth, and myselfe with one or two more then in company went in to see it. It was kept in a chamber, and was a great fowle somewhat bigger than the largest Turky Cock, and so legged and footed, but stouter and thicker and of a more erect shape. . . . the keeper called it Dodo.

After death this specimen was stuffed (badly no doubt) and exhibited in Tradescant's Museum. Finally it made its way into the Oxford Museum, but during the winter 1754–55 a general housecleaning took place. On January 8, 1755, the curator got to the dodo and decided that it was too motheaten to remain on exhibit. He ordered it thrown away. Somebody had the good sense to recover the head and one foot from the trash pile. They are the only remains of the only stuffed dodo that ever existed.

It was thrown away when the bird was already extinct—the precise date of extinction is not known, but none could be found any more on Mauritius in 1693. It had been killed off mainly, not by direct persecution, but by introduced domestic animals, especially hogs which ate the eggs and the young birds. And the flightless dodo could not lay the eggs in places inaccessible to hogs and dogs. Last mention of a living dodo dates from 1681; the extinction falls into the decade after that year.

In 1778 naturalists tried to find traces of the dodo on Mauritius; the residents of that island doubted their story that such a bird had ever lived there. In 1865 another dodo hunter, G. Clark, was more successful: an old swamp yielded a fair amount of dodo remains which were sent to England. They were examined by Richard Owen, who confirmed a tentative guess made by the German Professor Reinhardt some years earlier. Reinhardt had thought, and Owen confirmed it, that the dodo of Mauritius and its relatives were related to the pigeons. They were, or had been, descendants of pigeonlike birds that had grown huge and flightless on their islands.

Some years later, in 1889, the old swamp of Clark's discovery was excavated more thoroughly by the government of Mauritius, and enough bones were recovered to yield the several complete and almost complete skeletons for the few museums privileged to shelter them.

That is the story of *Didus ineptus* or *Didus cucullatus,* the Mauritius dodo. It simply bristles with loose ends, but it is still relatively complete when compared with the stories of the other dodolike birds from the other islands.

Didus borbonicus of Bourbon-Réunion is sometimes called the "white dodo." It seems to have resembled the Mauritius dodo very closely, except that it was much lighter in color. At least one of the old paintings shows such a "white dodo." Mentions of it are few and far between, the main (and rather scant) sources are Tatton in 1625, Bontekoe in 1645, and du Bois in 1669.

As far as can be ascertained now, the two dodos must have been very much alike, except that the Réunion variety was of a much lighter color. Occasionally *Didus borbonicus,* which seems to have survived the Mauritius dodo by half a century or so, has been referred to as *Didus solitarius,* or the solitary dodo; this has caused much confusion, for the name solitarius belongs by right to a third extinct but different bird, *Pezophaps solitarius,* which lived on the island of Rodriguez three hundred miles east of Mauritius.

Credit for naming this last bird goes to François Leguat, who lived for a time on Rodriguez. Leguat wrote that "of all the Birds in the Island the most remarkable is that which goes by the name of Solitary, because it is very seldom seen in Company, tho' there are abundance

of them." The solitary was of considerable size, the males standing two feet nine inches high and weighing up to forty-five pounds. The females were slightly smaller. While unable to fly, the wings of the solitary were not as much atrophied as those of the dodos and were equipped with a curious, almost spherical growth of bone "the size of a musket ball," which formed a rather effective weapon of defense. Leguat praised the "admirable taste" of the solitary, which may be the reason why none was ever brought to Europe.

Leguat's solitary was once slated to become a constellation in the sky. That it did not do so was due to a lack of zoological knowledge on the part of the astronomer. On June 6, 1761, the French astronomer Pingré was on a trip to Rodriguez in order to observe a "transit" of Venus across the disk of the sun, a rare occurrence. And in honor of Pingré's trip and of the strange bird that had once lived on Rodriguez, his compatriot and colleague Le Monnier decided in 1776 to use a few stars he had discovered in the space between the constellations Libra, Scorpio, and Draco to create a new constellation and to call it Solitarius. To get a picture of the solitary, Le Monnier consulted Brisson's great *Ornithologie,* which had been printed in 1760. He did not know that Brisson had not included the solitary in his book. Looking in the index, Le Monnier did, however, find a *solitaire* listed, and he faithfully copied the picture on page 268 of Part II to which he was referred. Thus it came about that the heavens bore a new constellation Solitarius to which had been given the imaginary shape of *Turdus solitarius,* the solitary thrush!

It remains to dispose of a few pseudo-dodos which have crept into literature since 1600. For some time zoology texts spoke not of three but of five or even six extinct birds on the three islands. Leguat had also reported some birds he called *géants* (giants) because they stood six feet tall. No one else ever mentioned them, and ornithologists had to decide whether to believe that Leguat had seen the last of still another variety which died out even more quickly than the others, or to assume that he had made a mistake. For a while the first alternative was chosen, but now it is believed that Leguat's *géants* were simply well-known birds not normally belonging to the fauna of Rodriguez, namely, flamingos. In fact, Leguat's short description as to height, ap-

pearance, and color corresponds well with the height, appearance, and color of flamingos, although it is rather strange that Leguat did not notice the curiously shaped beak.

The second of the pseudo-dodos is the large and flightless "forest bird" of Mauritius. It would be a complete puzzle if it were not known that this forest bird, which was under discussion for some time, appeared in German books first. Now, the German word for forest bird is *Waldvogel*—somebody who thought he knew Dutch but didn't had mistranslated van Neck's term *Walghvogel.*

And the third, the extinct dodo of Nazareth, had a similar origin. The French had translated *Walghvogel* literally and correctly as *Oiseaux de nausée.* But one François Cauche, who spent two weeks on Mauritius in 1638, wrote about the dodos *"nous les appellions oiseaux de Nazaret."* In translation: "We called them Nazareth birds." Cauche, in all probability, had misunderstood the word *nausée* (or didn't believe his ears since the dodos looked comical or strange or anything else but certainly not nauseating) and substituted *Nazaret,* which sounds similar in French. Hence a dodo of the island of Nazareth appeared in the books, complete with the Latin designation *Didus nazarenus.* You also could look up the island of Nazareth on a nautical chart, close to Mauritius.

The only trouble was that the island of Nazareth existed on maps only. It had been placed there as the result of a faulty determination of position. Actually it was one of the Mascarene islands, discovered once more and thought to be new because it seemed to be in the wrong place. Actually the island of Nazareth existed only as a mistake.

And so did *Didus nazarenus.*

Since the dodo became really well-known after its extinction its name has become proverbial for that of an animal that becomes extinct under man's own eyes. Yet the phrase could have been, with equal justification, "as dead as the moa." This in almost every respect mysterious bird from New Zealand is the dodo's most famous rival in the gallery of recently extinct animals.

Like the dodo, it was flightless; like the dodo it was large and heavy, but much more so. The moas were as tall as men and taller,

bearing some outward resemblance to ostriches. But they were much more massive than any ostrich alive.

Unlike the dodo, the moas roamed over a rather large territory. Abundant remains have been discovered on both islands of New Zealand. Some of these remains are true fossils and date back to the late Miocene sub-period of the Tertiary. A row of footprints has been classified as having been made during the Pliocene sub-Period. But the great majority of the moa remains—bones, skulls, eggshells and even a few feathers—are only a few centuries old. The crux in many cases is "how many centuries"?

From those remains it could be established that there were about two dozen different species of moas, belonging to five well-defined genera, namely:

Dinornis—six species
Megalapteryx—two species
Anomalopteryx—five species
Emeus—four species
Euryapteryx—five or six species.

Two of these names end with "apteryx," which is the name of the small kiwi or kiwi-kiwi that is still alive, a last and small but not forgotten offspring of the moa tribe which will be treated with more detail in the third part of this book.

Not all the moas were giants, but even the smaller species still stood about five feet tall. The real giants, like *Dinornis robustus,* towered to a height of twelve feet. Some well-preserved eggshells of the smaller types measure 8 inches in length, 5½ inches in width, and more than 17 inches in circumference. But other eggs measured even 21 inches in circumference. However, it cannot be said with certainty to which type those largest eggs belonged. The size of a bird does not always correspond to the size of its eggs; in one case a larger egg has been assigned to a smaller type of moa, while a smaller egg is pronounced to have been laid by one of the larger types.

Nothing was known of the moa until about a century ago. None of the early explorers even mentioned having heard about it. The Netherlander Tasman did not land when he sighted New Zealand in 1642, but Captain James Cook should have heard about moas when he landed

there in 1769. Cook questioned one of the native chiefs, Tawaihura by name, about the animals on the island and records, among others, a vivid description of a large lizard (which does not exist), but of the moa, not a word. Between 1800 and 1830 at least six books were written about New Zealand, none of which so much as mentions the bird.

In fact the first mention does not occur until 1838. In that year there was published in England a book on New Zealand by J. S. Polack, a Jewish trader who had lived on New Zealand from 1831 to 1837. He remarked that on North Island, where he had lived, "there once existed a bird of the struthious order equal in size to the emu," and said that he had seen bones of that bird and that he believed it was still alive on South Island. Another early explorer of the moa country, the Reverend William Colenso, later tried to discredit Polack's story, saying that Polack could not have written the book because he could not write and that Polack could not have seen moa bones because "if so, he surely would have grabbed them." Colenso himself laid claim to being the first white man to report the former existence of the moa. It is not known what incited Colenso's dislike for Polack; but though it may be true that Polack could not write, the fact remains that a book under his name exists and that it speaks of moas earlier than any other book.

Colenso became interested in moas because natives had told him that a lone and much feared survivor of these birds had established a reign of terror on and around the mountain Whakapunake. At first he thought the story wholly fictitious. During the following years, however, he received proof that such birds had existed, and he was inclined to believe the legend about a lone survivor. When he returned to the East Coast in the summer of 1841–42 (remember, this is the Southern Hemisphere) he entertained some hopes of investigating Mount Whakapunake, but the natives were so afraid that he could find no guides. In the meantime, however, Christianity had gained a foothold among the natives under the teachings of the Reverend William Williams, and some Christianized Maoris had made the trip by themselves, without encountering a living moa of any type.

Some time during the year 1839 a large bone had been brought to

the British naturalist Professor Richard Owen. Unfortunately both ends were broken off, but Owen was interested because the bone had come from New Zealand and because it clearly showed that it was at least a century old. Judging from the size alone, Owen first thought that it must have belonged to an ox; but in comparing it with the skeletons of cattle, he could find no corresponding bone. Puzzled, Owen tried the skeleton of a horse, again without success. Besides, under closer scrutiny, the bone looked as if it might have belonged to a bird and not to a mammal. The largest bird then known was the ostrich, and while the leg of the ostrich actually yielded a comparable bone, the one from New Zealand was larger and much heavier. Professor Owen felt obliged to conclude that a bird like an ostrich, but larger and more sturdily built, had once existed in New Zealand. Although he was certain about his conclusion, he did not want to report the discovery until more material was available. Friends persuaded him to publish a paper on the bone, because it might open the eyes of travelers and explorers. Owen did publish a report, but before it arrived in New Zealand a large collection of moa bones had been brought together and shipped to England in a gigantic crate, which is said to have confounded customs inspectors because they had nothing in their rules and regulations that could be applied to shipments of fossil bones.[1] The resulting monograph, *On Dinornis,* finally established the existence of several varieties of moas.

During the latter half of the nineteenth century the collections of moa remains grew by leaps and bounds, and innumerable descriptions and papers appeared. None of them, however, answered two most important questions: Just when did these birds die out? Or are they possibly still alive? The possibility of living moas was very appealing. It was only natural that various people should try to gain notoriety by

[1] Zoological shipments have often worried customs inspectors. One of the famous instances was a tank-car full of Mediterranean sea life that was dispatched by German zoologists to Berlin in 1927. En route it passed through Italy—and since Italy then had a very high export duty on salt, the customs inspector reasoned that a tank-car full of sea water was not exempt from that duty. Thus, surrounded by grinning scientists, he spent several hours figuring the exact amount of salt in such a shipment. Reportedly Mussolini personally ruled that sea water was exempt from salt export duty if used to accommodate living marine animals addressed to scientific institutions or individuals.

telling about having seen them. Unfortunately, such encounters occurred always in the dark of night, when frightened dogs could not be made to attack and when shots went wild.

How profound was (and still is) the wish for live moas can be seen from a rather harmless and not even intentional hoax that was perpetrated in 1919. A Wellington, New Zealand, journalist, Mr. Ivan M. Levy, wrote, for the pure fun of it, a story entitled "Cornered by a Moa," in which he told that while in the interior of North Island he was caught in a thunderstorm which left him horseless. The next days, while wandering on foot "without the remotest idea of locality or direction," he encountered a moa of rather nasty disposition which immediately attacked and almost killed him. Much to his surprise Mr. Levy saw his story reprinted in more or less shortened versions in almost every country on earth and found it hailed as "definite proof that there are still living moas." Even the New Zealanders were doubtful whether it might not be true. Mr. Levy, I repeat, was not trying to hoax his public; he knew that no reputable white man had ever seen a living moa, except, perhaps, for some very early encounter in which the man did not survive to tell the tale.

With the Maoris, of course, the story is quite different. There can hardly be any doubt that the forefathers of the living Maoris knew the moas well, that they hunted them, battled with them, and ate them. It is known, moreover, that the Maoris have not lived on New Zealand since forgotten times, but that they arrived there only two centuries or so before Abel Jansz Tasman.

A widespread ethnological belief once had it that the Maoris were forced, by lack of adequate food, to migrate to New Zealand from their original home, that on New Zealand they hunted the moas until the last big bird was killed off, and that afterward they reverted to cannibalism because man was the only large animal left on the islands. Though it would be tempting to bring together two such interesting subjects as moas and cannibalism, it must be admitted that the roots of cannibalism among the Maoris are older than the extinction of the moas and do not spring from mere hunger. Nor does proof exist that the Maoris were mainly responsible for the extinction of the birds. Some investigators have said—perhaps also an exaggeration—that the

first of the Maoris arrived just in time to see the last of the moas die.

Three different natural causes have been blamed for the vanishing of the moas. One of these is simply disease. There is plenty of evidence to be found in the structure of the bones collected from caves and other places that their original owners were not healthy. An extended rainy period has been named as the second most important cause. The moas, which fed indiscriminately on vegetation, are thought to have preferred open, dry country, almost steppelike conditions. In addition to disease and rain, New Zealand's volcanoes are blamed for the killing of many birds. There exists evidence that some, and possibly many, moas succumbed during an active period of the volcano Rotorua. Others were certainly killed by fires caused by volcanic eruptions, lightning, or man; and this cause would assume added importance if it could be established that the moas really could not swim, as the Maoris claimed. It is only too likely that a bird of the weight and shape of the moas was lost in deep water. But whatever the theories, it is only too likely that the Maoris put the finishing touch to the process by killing off the remaining birds. Even the date of their last hunt can be established with only little uncertainty.

At the time that the shipment of bones to Professor Richard Owen had definitely established the reality of the moas, a few old Maoris who in their youth had seen the living birds were still alive. In 1844 Governor FitzRoy met in Wellington the Maori Haumatangi, who took pride in telling the governor that he had seen Captain Cook. Since Haumatangi was then eighty-five years of age, he must have been a boy of fourteen when Captain Cook anchored off shore in November 1773, and his statement therefore seemed entirely credible. The Maori assured the governor that he had seen the last moa in the province about two years before Captain Cook came. Another old Maori, Kawana Paipai, asserted that he had helped to hunt moas on the Waimateb Plains when a youth. The year would have been about 1800.

Both men were explicit in their statements, telling how the moas were cornered and speared. They stated that the moas fought back by kicking with their powerful legs and that the Maoris used a technique of attack adapted to the birds' habit of standing poised on one leg.

Some of them approached the bird from the front, to make him raise one leg, ready to defend himself, while others, sneaking up from behind, tried to fell the bird by striking at the other leg with a long pole.

The reason the Maori tales can be taken pretty much at face value is that they relate details which tally with scientifically established facts. The natives insisted, for example, that the moa had a high feather crest on its head; the skulls of at least some of the varieties show that the birds must have had some similar ornamental headdress. The Maoris also asserted that the moa used to swallow little pebbles; remains have shown that it did. Also it is doubtless true, as the Maoris claimed, that the moas were not nocturnal in habit like the kiwi, but that they used to sleep at night, standing storklike on one leg. The kicking habits are typical of living ostriches, and it is very likely that the moas defended themselves in the same manner. The Maoris said also that the birds preferred seclusion, but were not timid.

The main reason that contact between Maoris and moas had been doubted at all was the complete lack of mention of the birds in early reports on New Zealand. There is, however, an explanation for this. It seems that most, if not all, of the Maoris with whom the early white visitors had contact had come from the northernmost part of North Island or from the west coast of the same island. The finds of moa bones prove that the birds were most numerous in the southeastern sections of both islands. Originally the birds certainly ranged over the whole of both islands, but when they began to recede they probably became rare first in the northwestern part of each island. Maoris from these sections might not have known the birds that were still alive elsewhere.

Altogether, it would seem that certain skeptical scientists are wrong in refusing to believe that the moa could have lived on into comparatively recent times. It is, of course, impossible to establish a fairly definite date for the departure of the last moa. Such previous attempts are, as T. Lindsay Buick—who, about ten years ago, wrote a comprehensive popular book on the extinct giants of his native New Zealand—put it, "a structure upon a foundation of doubt, cemented by uncertainty."

In spite of its many and obvious holes the story of the moa is still

reasonably complete. But of another extinct bird, also resembling moas and ostriches in external appearance, we really don't know much more than the fact that it once existed and became extinct some time between the time of Christ and now.

I am speaking of *Aepyornis ingens* of Madagascar. Being of a somewhat more slender build than the taller varieties of the moas, *Aepyornis* would have towered over the tallest of them by about two feet. That, of course, is something we know from reassembled skeletons. We also know the eggs of *Aepyornis,* which had a capacity of about two gallons. But there is no way of even guessing at the date of its extinction. Marco Polo was apparently told about *Aepyornis,* but under the name of "rukh" or "roc" which is familiar to us through the *Arabian Nights.* But what he was shown as evidence was a "wing feather" of such a roc, in reality the dried frond of a certain palm which actually does look like a gigantic bird feather. Marco Polo cannot be quoted as proof that *Aepyornis* was still alive in his time.

Although of a much more recent date than Marco Polo's narrative, a book by the French Admiral Gaston de Flacourt is much more definite in its statements. It was published around the middle of the seventeenth century and de Flacourt did see *Aepyornis* eggs, or rather eggshells, used as water containers. Since these eggshells were quite sturdy it does not necessarily follow that the eggs were fresh at the time of de Flacourt's arrival. But he said that there were gigantic ostriches living in the interior. He did not see one himself, because he was told that they inhabited only the most inaccessible places. He was also told that they were shy and timid in spite of their size. This lends a touch of reality, because a native hunter would be much more likely to brag about the ferocity of the beasts he is hunting.

As late as 1867 the natives insisted that such birds were still alive in those inaccessible places of the interior, but no reliable witness ever saw one and the lingering hope that a few of them may be found and if possible caught alive has been reluctantly given up several decades ago.

Since Aepyornis brought us to the geographical vicinity of Africa we might as well deal with the quagga next. It is a case which resem-

bles that of the American bison to some extent, but lacks the happy ending of the bison story.

The quagga was a wild horse, a relative of the zebras which could easily be distinguished from other zebras because it was only "part zebra" as far as coloration goes. The forepart showed the typical zebra striping, the rear end was uniformly dun-colored. No one would ever have seriously believed that the quagga could become even rare. It was because of its vast numbers the favorite game of the South African Boers when it came to getting "beef" for their Negro servants. Then one day, during the latter part of the nineteenth century, the wild quagga disappeared.

Zoological gardens in other parts of the world were not particularly well stocked with quaggas; there seemed to be no need for such a precaution. Moreover, the significance of the quagga's disappearance was not realized at once, not even in the Boer country. Consequently directors of zoological gardens soon found themselves confronted with a situation which could have only one outcome: extinction. There were no more quaggas to be found in Africa, although just those who knew South Africa best refused to believe it. And in the zoological gardens there were maybe a dozen quaggas, most of them of veteran age when the truth came to be known. They were too old to be bred and their small numbers might have been insufficient anyway. They just died off one by one. One morning in 1879 the last zoo specimen was found dead.

Equus quagga was extinct.

Our next story is an outgrowth of the first discovery of America from the West, undertaken by order of Peter the Great of Russia. To history the venture is known as the trans-Asiatic expedition which Peter had entrusted to a man whom he affectionately called "Ivan Ivanovitch" with imperial disregard of the two minor facts that the man's name was not Ivan and that his father's name had not been Ivan either. He was not even a Russian but a Dane, the son of Jonas Svendsen, who called himself (using his mother's maiden name) Vitus Bering Svendsen. To us he is known as Bering.

The episode which is of interest to us is really the end of the second

trans-Asiatic expedition. The order had been to find out just how Asia ended in the East, whether it was connected with America, whether there was a sea in between the two continents, and whether there were other lands in that sea. After a long and perilous journey the expedition had finally reached the coast of Alaska. By this time Bering was completely worn out, sick, and in despair about the whole venture. After landing, the expedition's naturalist, Georg Wilhelm Steller, had set out on a trip of exploration. Only hours later Bering called him back. Steller argued with fire and much justification, but Bering had reached the breaking point. In spite of anything Steller might say he ordered the expedition's return to Asia. It is small wonder that Steller entered a bitter reflection in his diary: "Ten years Bering prepared for the great enterprise," he wrote, "the exploration lasted ten hours!"

Returning in extremely bad weather, the ship entered what was thought to be a channel along the coast of Kamchatka. Actually Kamchatka was still some one hundred fifty miles away and it was merely an island, cold, unpleasant, and flat; we now know that its highest elevation is three hundred feet. To the crew, weakened with hunger and exposure to cold and wind, sick with scurvy and related ailments, it seemed as if their *St. Peter* was to be dashed to pieces on the cliffs which they saw between them and the safe harbor. But they were too weak to do anything about it, and the ship was too battered herself to take any more punishment. Anchors were dropped, but the ropes broke. Miraculously the next swell of the sea carried the *St. Peter* across the chain of cliffs. She was safely in a natural harbor of the island.

The sick and the dying were brought on land, among them Vitus Bering, the leader of the expedition. Unwittingly he had discovered a new island which was to bear his name. "He died on the 8th of December 1741, two hours before daybreak," Steller entered carefully in his diary.

The shipwrecked crew of the *St. Peter* found itself quickly surrounded by numbers of small blue foxes, relatives of the white arctic fox. They were probably shipwrecked themselves, except that their "ships" had been just ice floes. To those foxes Bering's Island

was a safe refuge since they had no natural enemies there. But this advantage (which made them multiply enormously) was offset by the fact that there was little nourishment to be found. They seem to have subsisted mostly on baby sea lions and baby fur seals which had been crushed to death inadvertently during the night by their parents. To the sailors they were pests, about as welcome after a while as locusts. They stole what they could and the sailors killed as many as they could, only to see twenty killed foxes replaced by forty live ones. It was plain war for food, because the foxes were inedible, even to starved sailors.

Since there was no edible life on land, the sailors had to subsist on the mammals of the sea. For more than six months their diet of fresh meat was almost exclusively sea otter, with an occasional variation provided by seal, fur seal, or sea lion. But these were usually too clever to be caught on land. And the sea otters were learning fast. But there was one more source of food, a gigantic sea mammal of strange fish shape, up to thirty feet long and weighing eight thousand pounds when full-grown. These fish-shaped mammals had been disregarded at first since they never came on land—they couldn't—but after a while the sailors succeeded in harpooning them in shallow water and dragging the bodies up.

> This marine mammal which became so useful to us [Steller wrote] has been discovered first by the Spaniards in America and was called manatee by them, but the Dutch and the English call it sea-cow. The largest of them are 4 or 5 fathoms long and measure 4½ fathoms around near the umbilicus where they are thickest. The weight must be 1200 *pood*. The animal resembles a seal down to the umbilicus, from there on a large fish. The skull is not too different in its general shape from a horse's skull, when it is still covered with flesh and hide it resembles a buffalo's head. Instead of teeth there are elongated flat loose bones, one on top and one in the lower jaw on each side. Both have many furrows between which the animal grinds its normal food, seaweed. The lips have many thick bristles . . . the eyes of this large animal are small, like those of sheep . . . while its diameter decreases in the rear it is still two feet thick just in front of the tail. As distinct from the whales the animal does not have a fin on its back.

Steller had guessed correctly that this marine mammal was a relative of the Florida manatee and the African dugong, but it seems that he

himself had never seen a manatee or a dugong. It would have made his description much simpler if he had referred to them. Needless to say that the dugong and the manatee are much smaller; it is quite possible that a baby of Steller's sea cow was about the same size as a full-grown manatee.

As regards their food value Steller had nothing but exorbitant praise:

> Their fat is not oily but hard and as white as snow, after lying in the sun for a few days it is yellowish like best Dutch butter. Boiled by itself it far surpasses the best beef fat in taste. Rendered it is as liquid and yellow as best olive oil and of a nice clean smell, we drank it by the bowlful without experiencing any nausea. The tail of the animal is almost all fat. The meat of the calves resembles pork, that of the cows veal, it boils through in about half an hour and gains in size while boiling to about twice its original volume. The meat of old animals cannot be told from beef and can be left for two weeks on the air even in hot summer without spoiling, except that botflies will get at it. . . . How healthful this meat is was felt by everybody, especially by those still suffering from scurvy.

Steller did not see Europe again, although he and many of his companions succeeded in leaving Bering Island. He died in November 1746 during the return journey.

After Steller's enthusiastic report—even if it was not published at once—and especially after his remark that these "animals occurred in large numbers all year round," one should expect many references to the sea cow of the High North, especially since the Russians became quite interested in the eastern end of Asia and the many islands of the Bering Sea. A. E. Nordenskiöld seems to have searched all available sources and reported with surprise that he could not find many such references. There was one about the vessel of one Ivan Krassilnikoff, which arrived on Bering Island in October 1754 "to stock up on the flesh of the sea cow." There was another one stating: "After Korovin in 1762 had provided himself with a sufficient stock of the flesh and hides of the sea-cow . . . he sailed on."

But (quoting from Nordenskiöld's *Voyage of the Vega*): "In 1772 Dimitri Bragin wintered on Bering Island during a hunting voyage. In a journal kept at the request of Pallas, the large marine animals occur-

ring on the island are enumerated, but not a word is said about the sea cow. Schelekhov passed the winter 1783-4 on Bering Island, but during the whole time he only succeeded in killing some white foxes, and in the narrative of the voyage there is not a word about the sea cow."

Nordenskiöld also found mention of a petition by one Yakovlev made in November 1755 and addressed to the authorities in Kamchatka, requesting them to forbid the hunting of the sea cow. By that time they must have been very rare, but the year 1768 did not see the killing of the last of innumerable sea cows, as is claimed in most books. Nordenskiöld found what he considered reliable reports of occasional sea cows and sea-cow hunts in 1779 and 1780, and as late as 1854 a description of an animal that was indubitably a sea cow. The men who described it did not even know of Steller, yet they sounded as if they were quoting from his report. That particular sea cow was only seen, not hunted.

Nordenskiöld came to the conclusion that "the herds were rather driven away from the rich pastures on Bering Island than exterminated there; and that the species became extinct because in their new haunt they were unable to maintain the struggle for existence."

Steller seems to have had the unique experience of running into a kind of last stand of the great northern sea cow (Cuvier bestowed upon it the scientific name of *Rhytina (gigas) Stelleri*) comparable to that of the great auk on Geirfuglasker. Its only two living relatives are decidedly tropical in their habits and the fossil relatives that are known also seem to have lived exclusively in warm climates. It seems quite likely that *Rhytina* was a last remnant of probably vast herds of sea cows which inhabited the area of the Bering Sea in Tertiary times. The climate of the Bering Sea in those days, especially since a land connection between Asia and America protected it from the cold waters of the Arctic Ocean, must have been comparable to, say, South Carolina, or rather the ocean off South Carolina.

What Steller found was merely a last surviving herd. He did not try to estimate their number but just stated in general terms that they were "numerous" or "abundant," but that refers to the immediate vicinity of the island on which he was marooned. Later writers have tried

to make out some fifteen hundred or five thousand sea cows at Bering Island, and in popular accounts that has grown to a whole Bering Strait thickly populated with sea cows. But Dr. Leonhard Stejneger, who visited Bering Island and had a lifelong interest in Steller and his doings, pointed out that Rhytina was not only large and bulky and impressive on that account, but that it also seems to have lived chiefly near the mouths of rivulets, in short, within view from the coast. If these small sections were visited regularly by a few herds of, say, fifteen or twenty individuals, each one big, it would have been easy to call them abundant, although the total might not have surpassed a few hundred individuals.

Steller's sea cow has brought us to America, where there are two quite spectacular examples of animals vanishing before our eyes. The two I have in mind are both birds, and their names are still known to almost everybody. One was the heath hen, the other the passenger pigeon. As for the heath hen, the story has been told in a nicely condensed form by Dr. W. C. Allee in his book *The Social Life of Animals* from which the following is taken:

> The heath hen was most abundant in Massachusetts, but by 1850 it had been killed off until it was to be found only on Martha's Vineyard and nearby islands and among the pine barrens of New Jersey. By 1890–1892 the birds had diminished to a scant two hundred at most, restricted to Martha's Vineyard. As soon as the "bird stuffers" heard how rare they had become, prices went up and museum collectors rushed in to get specimens before they disappeared like the dodo. By 1907 the count had been reduced to seventy-seven. The Heath Hen Association was formed. The society arranged for almost three thousand acres of protected range for the birds. By 1916 their numbers had increased to two thousand.
>
> Then came a fire, a gale, and a hard winter, with an unprecedented flight of goshawks, and in April, 1917, there were fewer than fifty breeding pairs. The next year, when there was an estimated total population of one hundred and fifty, the heath hen range was invaded by several expert photographers who took motion pictures of mating behaviour. In the face of this disturbance at a critical time, still a good year allowed the birds to increase and again spread over Martha's Vineyard. In 1920 three hundred and fourteen were counted; but thereafter a decline in numbers set in which was never stopped.

The counts of those remaining years are available. They read:

1920	314
1921	117
1922	100
1923	28
1924	54
1925	25
1926	35

It was a steady fluctuation of small numbers, but as a whole the count went down and down and down. The last one seen, in 1932, was a banded male. The following year, 1933, may be taken as the year of the extinction of the heath hen.

But the story of the heath hen is like nothing when compared with that of the American wonder bird, the passenger pigeon. People in Europe just could not believe what they were told about *Ectopistes migratorius,* the scientific name given to that phenomenon. *Ectopistes migratorius,* long-tailed and beautiful, could travel at the then unheard-of speed of sixty miles per hour. It was able to keep this up for half a day or more. And it appeared in simply fabulous numbers. Zoology books quote with awe what Audubon had written about them:

> In the autumn of 1813, I left my house at Henderson, on the banks of the Ohio, on my way to Louisville. In passing over the Barrens a few miles beyond Hardensburgh, I observed the pigeons flying from north-east to south-west, in greater numbers than I thought I had ever seen them before, and feeling an inclination to count the flocks that might pass within the reach of my eye in one hour, I dismounted, seated myself on an eminence, and began to mark with my pencil, making a dot for each flock that passed. In a short time finding the task which I had undertaken impracticable, as the birds poured in in countless multitudes, I rose, and counting the dots then put down, found that 163 had been made in 21 minutes. I traveled on, and still met more the further I proceeded. The air was literally filled with pigeons, the light of noon-day was obscured as by an eclipse, the dung fell in spots, not unlike melting flakes of snow, and the continued buzz of wings had a tendency to lull my senses to repose.[1]

Audubon reported that this particular "swarm" continued to pass

[1] *Ornithological Biography,* Vol. I (Philadelphia, 1831).

in "undiminished numbers for three days in succession." When such flocks alighted, trees broke down under the weight of the birds and no mass slaughter could make the slightest impression on their numbers. It was so much "a scene of uproar and confusion" that the great naturalist "found it quite useless to speak or even to shout . . . the reports of the guns were seldom heard, and I was made aware of the firing only by seeing the shooters reloading."

Audubon estimates the size of the flock as follows:

> Let us take a column of one mile in breadth, which is far below the average size, and suppose it passing over us without interruption for three hours, at the rate mentioned above of one mile in the minute. This will give us a parallelogram of 180 miles by 1, covering 180 miles. Allowing two pigeons to the square yard, we have one billion, one hundred and fifteen millions, one hundred and thirty-six thousand pigeons. . . . As every pigeon consumes fully half a pint of food, the quantity necessary for supplying this vast multitude must be eight millions seven hundred and twelve thousand bushels per day.

Such incredible flocks were a thing of the past during the latter half of the nineteenth century, but the bird was still considered "very common" in 1880. It may have been the year 1881 that was fatal to them. Trappers or "pigeoneers" used to catch them with large nets while the birds were breeding, but for every million birds they caught, several millions escaped. It was different at the biggest breeding ground, near Petoskey in Michigan, in 1881. The pigeons arrived earlier than usual and in numbers which were unbelievable even for the passenger pigeon, covering a much larger area than customary. Late in April the many millions of nests had been built and the eggs laid. A terrific sleet storm broke at dusk one day just during that critical period. The birds rose like clouds, but there was a heavy fog on Lake Michigan and they disappeared in it. When the trappers arrived for their usual catch, the beach was strewn for many miles with dead pigeons, and the stench in the square miles of woods was such that the men could not even enter.

The passenger pigeon could not recover from this blow, which seems to have destroyed the biggest flock there was in a few hours. Although still termed "not at all rare" in 1892, the pigeon was rare in 1895. A

total of two hundred was reported from all of Michigan in 1898 and in 1900 only fifty. The last wild pigeon was killed in Canada in 1907 near Quebec. And the last zoo specimen (named "Martha") died in the Cincinnati Zoological Garden on September 1, 1914.

The passenger pigeon had passed.

Cases like these, tragedies of mammals and birds that vanished not *before* but *while* Man was conquering his planet in search of gold, spices, furs, and knowledge, could not help but attract the attention of thinking people. Many were deeply concerned, and expressed, often quite volubly, a feeling of guilt for the whole human race. While this was an understandable reaction, it must also be admitted that it was difficult to fix the blame.

The Icelanders who braved the surf off Eldey could not be accused of being aware of the fact that there were only two great auks left in the world. The fishermen who had gone to Funk Island to "victuall themselves" had been within their rights. The starving companions of Steller could not be charged with having caused the extinction of the Northern sea cow, because they didn't. They killed at most some two dozen animals during their whole stay. And it was especially hard to present a case against the Dutch sailors who had grumblingly eaten "disgusting" dodos while waiting for an opportune wind. To accuse the Maori chieftains and their hunters of willful extermination of the moas was silly.

Considering all these cases, including those which had not quite led to extinction then, like passenger pigeon, heath hen, wisent, and some others, some zoologists arrived at the idea that Man had actually just helped Nature along. It looked precisely as if these species had been doomed to extinction by Nature herself, and it was concluded that there probably was something like a "natural life span" for a whole species. It looked as if a species, like an individual, has a faltering childhood, a vigorous prime of life, and finally a slow aging, ended by death. The dodos were an example of that, and most especially the incredibly numerous passenger pigeons. Some zoologists even went so far as to speak of this idea as a "natural law," and philosophers of the more gloomy variety did not fail to pick the idea up and to chant

the same warning that had loomed so fearsomely behind Cuvier's recurrent cataclysms: Beware, O Man, the next doomed species may be *Homo sapiens.*

After a short flowering that spurious "law" died too. It had been established on the strength of a few dramatic but isolated cases with careful neglect of everything else. To anybody even vaguely acquainted with the numberless species of animals that existed and became extinct before Man even appeared on earth, it was clear that it must be a most curious "law" which allotted a life span of three hundred million years to one species and of only some ten thousand years to another. Not only that the animals of the geologic past had lived for quite different lengths of time, some of them were still alive today!

If, then, there was no proof that a "life span law" existed at all, what did account for these rather sudden disappearances of whole races of animals? Was there an explanation that could include those more dramatic cases that had given rise to this whole philosophical trend of thought?

Three of the species actually destroyed by man—the quagga, the bison, and Steller's sea cow—happened to be the most easily hunted large animals in certain sections. To a certain extent this also held true of the moas, though they had already been diminished in numbers by such natural occurrences as gradually changing climate and vegetation and by such catastrophes as volcanic eruptions and the fires started by them. The great auks also had receded considerably before the final blows were struck. They were handicapped—as were the dodos—by a slow rate of reproduction and by the loss of the power of flight. In spite of these handicaps they could endure in peaceful surroundings for some time—but only as long as the surroundings remained peaceful.

The law that actually does apply to all these may be stated as follows: a species that is too strictly adapted to a given set of conditions is bound to face extinction if, as, and when these conditions change. The dodos, those flightless pigeons, could have been obliterated by pigs alone without the interference of man, because pigs might have been carried to "Zwaaneiland" on a floating log. The great auks would have been easy prey for *any* carnivorous animal. Both represented designs

that were inefficient for general conditions; they were capable of surviving only in very specific surroundings. It may be remarked that the penguins, too, would probably not survive long if they lived together with efficient carnivores.

There is a case on record which sounds like an illustration for these statements, the case of the Stephen Island wren. Stephen Island, about half a square mile of wooded rock, is just off New Zealand. For navigational reasons it needs a lighthouse, and the lighthouse-keeper had a cat. One day the cat came home with a strange bird in its teeth. The keeper took it away and sent it to England, where it finally came to Lord Rothschild, who established classification and name. The cat brought about a dozen more birds of the same kind within a few weeks. The keeper always took them away from the cat and saved them, which is the reason why there are specimens in several museums. The keeper never saw one of these birds alive. And after a while the cat stopped bringing them.

A carnivorous mammal could have come to Stephen Island without human assistance—remember the blue foxes of Bering Island.

But the passenger pigeon?

It was such an extreme case, too. Audubon, after describing a scene of mass slaughter, continued by saying that it might easily be thought that "such havoc would soon put an end to the species. But I have satisfied myself, by long observation, that nothing but the gradual diminution of our forests can accomplish their decrease." And when those forests went, the pigeons went with them.

These explanations are not intended as an apology for the misdeeds of some men in the past. They are intended to show that the only common element in all these cases is that the animal in question was fitted to a specific environment, and that specific environment only. Others, not so specifically adjusted, survived the same changes, sometimes even with an increase in numbers. It boils down to an evolutionary process which is hardest on the most precise adjustments. The first group might be likened to fine precision tools, especially made for a specific "niche of opportunity," very expensive, and to be handled with extreme care. The second are more like simple crowbars which are always useful even if there should be no use for crowbars, since

they could be made to work as hammers, pikes, supports, or simply as weights. But the chronometer which might be fashioned from the material of a crowbar can be used for almost nothing except for keeping time. The dodos and the moas, the sea cows and even the passenger pigeons, had lost the ability of readaptation. Their so-called "life span" ended when that ability was called for. And found wanting.

Part Three

WITNESSES OF THE PAST

For a thousand years in thy sight
are but as yesterday when it is
past, and as a watch in the night.

—*Psalm 90*

15: Limulus *and* Latimeria

THE BLINDING white dunes are very quiet. The water slowly recedes with the ebbing tide, exposing endless flats of very fine, light-colored mud which dries quickly under the rays of the sun. A strange crablike animal has been left behind by the tide. Trying to get back to the sea, it crawls bravely ahead, pushing its domed carapace forward by the movement of many hidden feet and trailing a dagger-like tail behind. But the air is hot and the mud thickens rapidly. Progress becomes more and more difficult. After thirty feet, the strength of the small creature begins to fail. In final desperation it threshes about wildly with its tail spike, leaving imprints on the mud. Then it dies.

A light wind blows offshore, bearing with it clouds of fine white dust from the dunes and the raucous cries of the birds that live in the forests and araucaria trees beyond. The dust settles on the moist mud, covering the dead "crab" and its tracks. Overhead strange flying animals circle in the warm air. They have long feathered tails and wings with free fingers that end in sharp claws, and scores of tiny, sharp lizard teeth. Pterodactyls, too, real reptiles with membranous wings, circle about looking for dead fish and cuttlefish and occasionally swooping out to sea. Far out in the water the long neck of a large marine saurian can be seen in pursuit of a school of fish. Farther to the north a sluggish stream empties into the sea, forming a coastal swamp with lush vegetation and abounding in terrestrial and marine life. Here are to be found fish with rather large heads and curious tails; though quick in movement, their fourteen-inch bodies have the inflexible look of wooden models.

This is a picture—as accurate as paleontology can render it—of an average hour on the shores of the sea that covered most of Europe during the Upper Jurassic Period, some hundred and thirty million years ago. The actual spot is near what is now Solnhofen, a small town in Bavaria, noted for the beautiful fossils that have been found near it; and Solnhofen has given its name to the whole animal life of a geologic area and period.

The city derives its name from a hermit, St. Sola, who once lived there and who certainly did not even dream of the scientific treasures in the ground trodden by his unshod feet. Long before his time, Roman legions on an expedition north of the Alps had discovered that a hard and very useful slate existed in that section. But Solnhofen and its slate did not come into prominence until Alois Senefelder invented lithography in 1793 and thereby created a demand for Solnhofen slate. Artists who sought to cover the precious slate with pictures soon saw that Nature had anticipated them. Fossils of a clarity and beauty surpassing anything yet found were already engraved on the stone. Consequently scientists appeared in Solnhofen as prospective customers.

The fossils were classified and, as usual, given rather difficult names. The birds with long tails and clawed "fingers," for example, were christened *Archaeopteryx*. The wooden-looking fish was described as a "coelacanth" and sonorously christened *Undina acutidens*. Along with quantities of pterodactyls there was found an unusually well-preserved—unusually beautiful even among Solnhofen fossils—"pre-butterfly," measuring ten inches from wing tip to wing tip, which was given the name *Kalligramma haeckeli,* in honor of the evolutionist Ernst Haeckel.

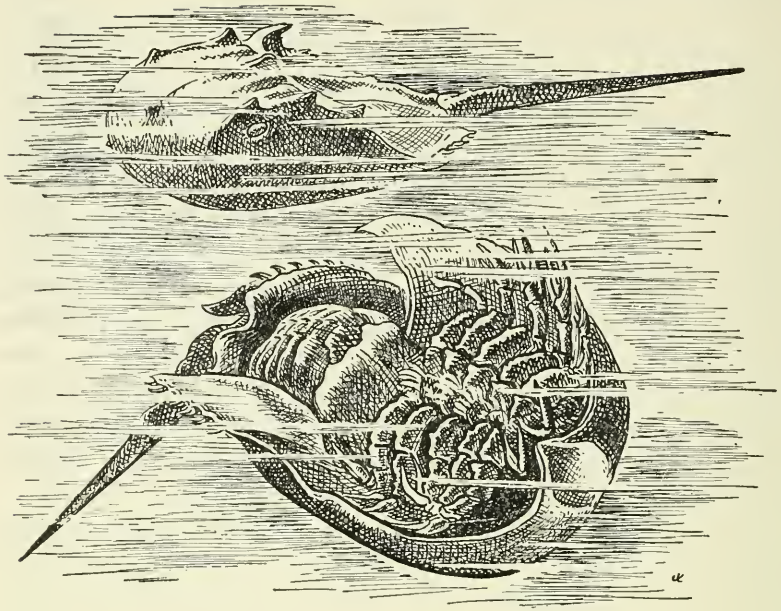
If Haeckel himself had been able to walk with his students along that ancient beach of a hundred and thirty million years ago, he might have pointed to the crablike animal trying to escape to sea and said: "Gentlemen, what you see there is a living fossil even now, in this Upper Jurassic. The same applies to those coelacanth fish we saw near the delta of the river. Neither should be alive now, both belong to periods hundreds of millions of years before this age of the first birds."

Then, after conducting his students back to his own nineteenth

century, he might have continued: "The strange truth is, gentlemen, that two very close relatives of this crablike creature are still alive in our own time. They differ little from each other; one of them lives in the shallow waters around the Moluccas, the famed Spice Islands near Celebes in the Malay archipelago; the other along the Atlantic Coast of the North American continent from Nova Scotia to Florida. In fact, it is even abundant in certain places—for example, in Long Island Sound and at the mouth of the Delaware River. This Solnhofen fossil we have here is termed *Limulus walchi;* its average length, including the tail spike, is six inches, while the living varieties, *Limulus moluccanus* and *Limulus polyphemus americanus,* are three or even four times as long when full grown. Gentlemen, if any of you should ever have an opportunity to go to America, don't forget to look for this most interesting survivor from ancient times. The American name for it is king crab or horseshoe crab."

European zoologists who come to this country never fail to look for the horseshoe crab. To them it is a highly esteemed and pampered inhabitant of their largest and best-stocked aquariums, usually acquired from the New York Aquarium in barter deals for European rarities. When they actually see one on the open beach they experience quite a thrill, though they know that the horseshoe crab is by no means rare. They are apt to fall into philosophical reveries over the strange fact that "America's oldest animal"—in fact, one of the very oldest of all living fossils—can be found within sight of Manhattan's skyscrapers. They may be mildly shocked to learn that the average American regards this interesting animal as useful only for fertilizer and possibly for poultry food when nothing better is available.

The horseshoe crab is, of course, not a crab; the trouble is, no one can say just exactly what it is. The scientific name is no more illuminating than the popular one: *Limulus* means merely "the cross-eyed." *Limulus* is certainly unique in outward appearance. No other creature has such a domed carapace and such a tail spike. But there are even stranger distinguishing features. While the milling appendages may to the casual glance look like those of any other crab, they are actually quite different. True crabs have two pairs of antennae or feelers; *Limulus* has only one pair, and since these bear claws they might with



Limulus, the horseshoe crab

(Drawing by Gustav Wolf)

just as much right be termed "legs." Finally, at the risk of seeming to be joking, I must at once add that *Limulus's* legs also serve as jaws. For the mouth of the animal is set between four pairs of strong legs, the upper parts of which are broad and flat and bristle with sharp spines. Working together the eight legs operate as a highly efficient shredding machine. The mouth has but to swallow what passes through the meat grinder, which, in turn, is fed with unprocessed pieces of food by the feelers.

Before this mechanism was fully understood, scientists had tried to learn about the horseshoe crab's diet by killing specimens and examining the contents of the stomach. This never met with any success; it required feeding experiments to find out what *Limulus* likes for breakfast. Some had guessed that it might be seaweed, but it turned out to be marine worms. However, *Limulus* is by no means squeamish

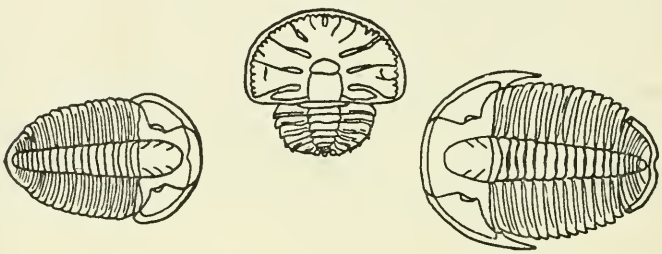
in its tastes; the test specimens also took to clams, crab meat, and even beef. Apparently it does not matter very much whether the meat is alive or not.

When the legs of *Limulus* are not busy walking or chewing they are used for burrowing in a hunt for food. They also serve as paddles when the crab swims, which, strangely enough, is done in an upside-down position. Finally, these versatile legs also have a sexual function. In the male the first pair of legs have somewhat hook-shaped feet instead of claws and these serve to hold on to the shield of the female when they are mating.

Limulus does not leave its native element under normal conditions, save for those that may be carried up by the tides—which sometimes happens nowadays, as it did a hundred million years ago. But at mating time—early in June, though sometimes in May or July—the females come to shore, carrying the males, which are noticeably smaller, on their backs. Occasionally three or even four males attach themselves to one female, trying to push the first one away. They come to shore with high tide, and it is observable that the higher tides around the time of the full moon are preferred. Having reached the high-tide mark the female begins to burrow, often so deep that only a small portion of the back of the male on top of her can be seen. The eggs are then deposited in this hole, and fecundated by the male.

The eggs of a single female will fill about a half-pint jar; their number is somewhat higher than ten thousand; they are greenish-blue and fairly transparent; in shape they are perfectly spherical, measuring about one-twelfth of an inch in diameter. After about one month the eggs hatch. The emerging young look very different from their parents. Three or four weeks later they molt and take the shape of the adults. During the first years of their life the young molt quite often, say half a dozen times. Later the molting is assumed to take place once a year. It is, incidentally, a much less trying procedure than with most crabs. The large cephalic shell opens at the front, where the animal is widest, and the horseshoe crab simply crawls out of the old and too tight armor. It almost looks as if it were only emerging from underneath a temporary cover. A few minutes suffice for the whole procedure.

All this has been going on without any changes for all of the hundred and thirty million years between the Jurassic Period and the present. And for a long time before this. But if the horseshoe crab was a living fossil as early as Jurassic times, what is the time to which it really belongs? Just when was it "normal," instead of being a survivor from the past? *Limulus* provides a clue of sorts by resembling another, well, call it crustacean, just prior to hatching. It does show a remarkable resemblance to a form of marine life which must have been



Limulus larva and trilobites: center, *Limulus* just before hatching; left, *Armonia pelops;* right, *Elrathia kingii.* The latter two are from the Middle and Upper Cambrian, Western Hemisphere. The three figures are not drawn to the same scale; the actual sizes of the three are quite different from one another

incredibly numerous in the very early days of the earth's history. These early inhabitants of the sea are known as *trilobites,* and their antiquity is shown by the simple statement that they became extinct some three hundred million years ago.

Since the unhatched *Limulus* does look like a trilobite, that would seem to prove that horseshoe crabs are descended from trilobites—but, unfortunately, we do not know too much about the trilobites either. When the first fossilized trilobites were discovered more than a century ago, they were believed to be strangely shaped clams or shells; and *Concha triloba,* three-lobed sea shells, was the name given to them. The latter part of the name has remained in use. They were taken to be clams simply because the only fossils then known showed only the dorsal side. Some investigators, however, suspected that matters

might be not quite so simple, and looked around for another explanation. While the British anatomist Shaw ventured the guess that they might be fossil caterpillars—at that time it was not known that there were some two hundred and fifty million years between the last trilobites and the earliest butterflies—others thought of centipedes or of a kind of apus, a small and rare crustacean with some outward similarity to centipedes. The Frenchman Latreille declared in despair that he would continue to accept the trilobites as clams until someone found legs on them and that if that came to pass he would thereafter regard them as centipedes no matter what happened. Finally an American, Walcott by name, discovered legs on trilobites by using main force and a hacksaw. He opened not less than 3500 trilobites that had been fossilized in a curled-up position; 270 of these showed legs. Soon after Walcott's discovery other fossil trilobites were found that had not curled up while dying, and these displayed their legs without the necessity of sculptural "dissection."

The short larval stage in the horseshoe crab's early youth proved that its ancestry had to be sought somewhere in that still mysterious trilobite group. But to explain one mystery with another was not very satisfactory, and so the hope was raised that the problem might be solved the other way round. If the anatomy of the living *Limulus* were completely investigated, the results might permit a few conclusions as to the nature of the extinct trilobites. Consequently, a number of excellent anatomical researches were carried out, almost all of them by American scientists who were near the source of supply. The results are still baffling to a large degree. The anatomical features of *Limulus* were found to consist partly of "crab," partly of "spider," with a good deal of "scorpion" thrown in; then there was a fair-sized remainder that was uniquely *Limulus*. The conclusion finally drawn was that the horseshoe crab is no more a crab than a primitive reptile of the group from which the birds evolved is a bird. As science sums up all the available evidence, *Limulus* is "a primitive predecessor of the scorpions and spiders adapted to marine life."

It should be added that the habit of living in the water is probably not an adaptation that came later, but another primitive and original feature. *Limulus* seems never to have left its original home, the shal-

low sea not too far from the shore. It is reasonable to assume, therefore, that the trilobites also inhabited shallow water, that they swam upside down like *Limulus,* and that they had the same strange kind of blood. The "blood" of the horseshoe crab does not contain the red iron compound, hemoglobin, attached to red blood corpuscles, but a blue copper compound, hemocyanin, which is simply dissolved in the body fluid.

Limulus is not only one of the very oldest of living fossils; it is also the most numerous living fossil. Henry W. Fowler, author of *The King Crab Fisheries in Delaware Bay* (1907), reports that around the year 1850 a resident of Town Bank could have collected 100,000 horseshoe crabs within a single week on his beach of a hundred rods. "On a half mile of the strand 750,000 were taken in 1855 and 1,200,000 were taken on about a mile in 1856." There was a special mill erected at Goshen for grinding dried horseshoe crabs into concentrated fertilizer. The product was sold under the name of "Cancerine" for twenty-five to thirty dollars a ton. The number of crabs coming to the shores of Delaware Bay decreased later, but is still large even nowadays. According to the *National Geographic Magazine* (Vol. 54, July 1928), in 1927 not less than half a million were stacked up to dry near Bowers, Delaware. The danger that *Limulus* may suddenly become extinct is very small indeed.

To repeat, *Limulus's* claim to fame as one of the most outstanding of living fossils is based on three facts: first, it is one of the oldest living animals; second, it is probably the most numerous living fossil; and third, it has survived not on some carefully isolated and protected island but in the open sea.

Occasionally, in a discussion of horseshoe crabs and living fossils in general, I have been asked whether some surprising and important discoveries along these lines may not be expected from the "real" deep sea, those almost inconceivable abysses below the two-thousand-fathom line.

It seems to be a perennially attractive idea that survivors from a forgotten past may have endured at the very bottom of the ocean, in an environment strange because of its eternal cold and darkness, but

otherwise undisturbed. For a while many professional scientists, influenced by a few chance discoveries, harbored similar thoughts. In 1836 Vaughan Thompson discovered in the sea near Queenstown an animal believed to be completely extinct. It looked like one of those beautiful long-stemmed "sea-lilies" known in the fossil state from the Jurassic Period. Sea-lilies, incidentally, are true animals in spite of their name, just as the well-known sea anemone is an animal and neither a plant nor something between plant and animal. Thompson's discovery was quickly followed by others: Pastor Michael Sars fished a similar form (which he called *Rhizocrinus lofotensis*) from a depth of five hundred fathoms near the Lofoten Islands. A few years later someone announced a real live trilobite raised from a depth of twelve hundred fathoms. The news was believed unhesitatingly—but then it turned out to be only something faintly resembling a trilobite and from a lesser depth.

As a matter of fact—and contrary to all expectations—the fauna of the deep sea is surprisingly recent. Some crabs look like epigones of Jurassic forms, like the eryonids, long-legged and with small claws. As fossils they are known from Solnhofen, and those fossils differ from the modern deep-sea forms mainly in showing eyes, which now persist only in the young. But the late Jurassic is the oldest period to which deep-sea forms point. The living fossils of the seas which are of a really old age all occur in shallow waters.

The sharks, one of the earliest and most successful designs for survival among fishes, are definitely surface raiders. *Limulus* lives in shallow water near the shore line and so do some clams which can boast an age equal to, if not higher than, that of Limulus. Even those sea-lily-like echinoderms that Vaughan Thompson and Michael Sars found accidentally, and which started the whole trend of thought that ended up in calling the bottom of the ocean the real Lost World, had not come from a very great depth.

It is not surprising, therefore, that the latest important living fossil of the seas was also found in shallow coastal waters. The discovery itself, however, was most surprising. It may sound exaggerated to say that the impact of this unexpected discovery, which was entirely

unheralded by rumor, was about the same as if a twenty-ton brontosaur had suddenly emerged from Lake Michigan and invaded Chicago; but actually it is an understatement.

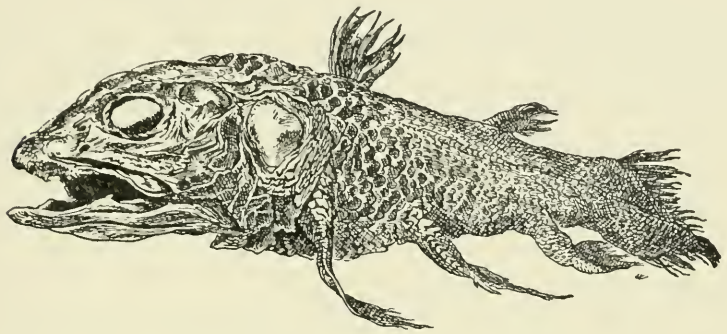
The find, a Christmas present to an astonished and grateful scientific world, occurred on December 22, 1938, when a large and strange fish was caught in the net of a trawler dredging in shallow waters off the tip of South Africa. The fish behaved in a definitely vicious manner, thrashing about and snapping at anything that came within reach. The fishermen looked with curious eyes at this five-foot creature, which they found to weigh 127 pounds, and decided that it was unlike anything they had ever seen before. If they should have decided, as well they might have, that the fish was probably inedible and therefore without market value, and had therefore dumped it overboard, the most important discovery since the okapi would have been postponed for nobody knows how long. Fortunately the skipper took another point of view. Market value or none, that fish was strange and should therefore go to a museum. Of course he could not decide to break off his fishing trip at once; the new fish, which had meanwhile died, was put on ice for the rest of the trip.

When the vessel put into port at East London the fish was promptly brought to the local museum. The curator, Miss Courtenay-Latimer, saw at once that the specimen was new and in all probability valuable. At the same time her nose told her that its condition was "high." A hurried request for examination of the specimen was dispatched to Dr. J. L. B. Smith, a leading South African ichthyologist; but before Dr. Smith could make the trip to East London, the fish had reached the state of being very much alive again, this time as innumerable microscopic units. To put a stop to this annoying development, Miss Latimer had the fish skinned and the skin mounted. She saved the skull and saw to it that what remained of the body was carried out as quickly and as far away as possible.

Dr. Smith arrived after all this was over.

Of course he regretted not finding a specimen fresh enough to be dissected with care and at leisure, but what was left convinced him that the net of the trawler had accomplished a really important discovery. The fish, which he called *Latimeria* in honor of Miss Latimer's

efforts, doubtless belonged to a known extinct variety. In fact, science had not only asserted that its type was extinct, it had given a fairly precise date for its extinction. *Latimeria* represents exactly the same type as that fish *Undina acutidens* from Solnhofen which had been a living fossil then, a hundred and thirty million years ago, just like the horseshoe crab.



Latimeria

(Drawing by Gustav Wolf)

Since it is one of the coelacanth fishes, it belongs to the subclass of the *Crossopterygia* or lobe-finned fishes which are distinguished from all others by having *two* dorsal fins, a different type of tail in which the backbone runs right through to the tip, a rather large and heavy skull, reduced gill covers, and very large scales that are covered with enamel. The crossopterygians represented the peak of evolution, the highest type of existing animal, some three hundred and fifty million years ago, at the beginning of the Devonian Period. While their form soon became obsolete, their descendants managed to stay at the top. The first newtlike amphibians evolved from the Devonian crossopterygians, and everything that followed, dinosaurs and birds, elephants and men, evolved from them. It happened dreadfully slowly, and the ways of evolution were as devious as chance could make them; but ultimately the whole zoo of today (visitors included) goes back to those first amphibians, which go back to the crossopterygians.

At the beginning of the Carboniferous Period, say two hundred and

seventy-five million years ago, the original crossopterygians were no longer needed. They became living fossils; that is, it would have been perfectly "normal" if they had become extinct right there and then, their usefulness fulfilled. But they clung to life tenaciously. At the beginning of the Triassic Period, when the first large saurians began to appear, these fish were still around, one hundred and fifty million years after the time of their glory. Another one hundred million years later, in the middle of the Cretaceous Period when the earth was shaking under the steps of the dinosaurs, there were still coelacanths in the seas, something incredibly old-fashioned. The end of the dinosaurs came with the end of the Cretaceous Period, about sixty million years ago, and it is from that time that the "latest" coelacanths were known.

It so happened that the latest specimens were discovered first, long before fossils of the Devonian varieties had come to light. They were found by Gideon Mantell, one of the first British paleontologists, more than one hundred and twenty years ago in the chalk of Lewes in Sussex, England. Mantell failed to realize that it was a separate group of fish and thought his fossil to be related to the living North American bowfin. But the great Agassiz, a famous Swiss naturalist specializing in fossil fish, corrected Mantell and named the fossil *Macropoma mantelli*. High-ranking experts, like Professor E. A. Stensiö of Sweden and Sir A. Smith-Woodward of England, spent much time and labor in reconstructing *Macropoma mantelli* from the fragmentary fossil remains known. This labor was not wasted. For it was on the basis of their work that *Latimeria,* when it was found alive and biting, was recognized for what it was. The experts had done an expert job—the living coelacanth and the reconstructed fossil look very much alike. Modern scientific methods proved their reliability.

The internal anatomy of the coelacanths (and of the crossopterygians in general) is, however, still unknown. And to learn about the internal organs of its Devonian ancestors, science must have another specimen of *Latimeria.* Everyone concerned is now wondering why *Latimeria* was not caught earlier. One resident of East London has stated that he saw such a fish on the beach in 1933, but he has been the only one to make such a claim. *Latimeria,* therefore, would not seem to be very abundant, at least not close to the shore. It is hardly likely that

Latimeria is normally a deep-sea fish that occasionally ventures into the upper layers. At I have said, it is the shallow waters that have so far yielded the living fossils of the sea. More probably the fish lives in depressions and crannies between rocks where a trawler's net does not reach. But perhaps *Latimeria* has been caught before and been thrown back as unknown and probably inedible.

And now everybody is waiting for more specimens of *Latimeria*. Somewhere off East London, around the hundred-fathom line, there must be more of them. And with luck one will be caught and if possible even kept alive to be studied. There is no end to the list of things which zoologists would like to know about the most amazing of all the living fossils discovered thus far.

16: A Century of Platypus

AS HAS just been told, *Limulus polyphemus,* the horseshoe crab, is probably the oldest living animal of our planet, not counting a few small marine or aquatic forms of life and a few dull clams.

And *Latimeria* was no doubt the greatest surprise among the living fossils.

But the living fossil *par excellence* is a mammal from Australia, the platypus. Reasonably abundant in its native habitat some fifteen decades ago, it escaped earlier extinction solely due to the fact of Australia's geographical isolation. And for the same reason it escaped earlier discovery.

While the name of its first discoverer is not on record we do know when and where it took place. The place was the countryside near Hawkesbury in New South Wales, Australia. And the time was the month of November (summer down there) of the year 1797. The man who caught the small animal must have been struck by its curious appearance, as everybody else since his day, and for want of a better name called it a "water-mole."

One may infer from this choice of name that the original discoverer was an Englishman. For while the platypus does make burrows and possesses a fur which may be likened to that of the common black European mole, the resemblance is slight. A Canadian or American who was acquainted with beavers would probably have picked "Australian beaver" as a name, because a swimming platypus resembles a swimming beaver in its general motions, the habit of burrowing at

the water's edge with an entrance hole under water is a beaver habit, and the platypus even has a somewhat flattened tail. Of course there is no real resemblance between the two, and beavers are much larger than platypi. Still, it would have been a more reasonable name.

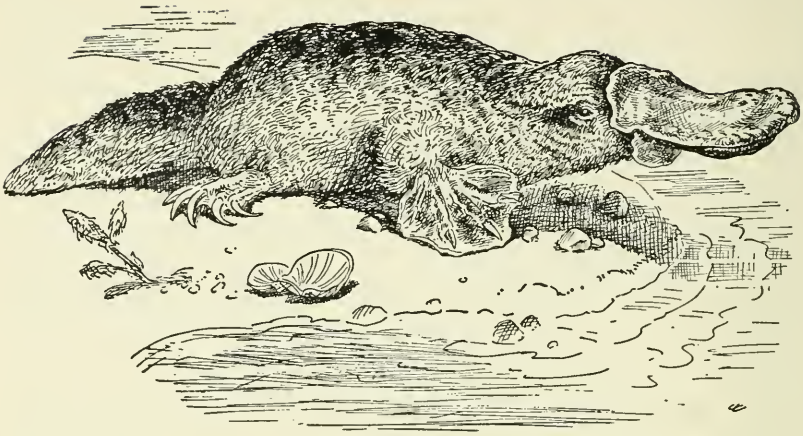
It is no exaggeration to say that platypus caused a scientific headache (not bothering the common man at all) which lasted a full century. Aforementioned headache began in 1798, grew in intensity some twenty years later, stayed strong for a little longer than that, and slowly began to recede afterward. It petered out during the last decade of the nineteenth century. Whether it began with the skin of that animal that was caught near Hawkesbury is uncertain. Possibly the so-called "original skin" which arrived in London was the same. If not, another specimen must have been caught within a week or two, something which is entirely probable.

The reasons why platypus caused such a long-lasting scientific headache were many and complex; we'll come to them point by point. But the reason for the first twenty or so years can be stated with a few words: it began because platypus would not fit into the textbook!

Around the year 1800 zoologists had nice, clean, and orderly textbooks. They began with the *Mammalia,* or mammals, and every student had to learn their distinguishing features. It was easy. All mammals were warm-blooded and had a skin characterized by sweat glands and hairs. The latter might be absent in special cases, such as elephants, hippopotami, and the tops of the skulls of elderly males of *Homo sapiens,* but even in these cases still a few hairs could be found. All mammals produced live young and suckled them, for which purpose the females had mammary glands (which provided the name for the whole order); they all had four limbs, while a tail might be present or absent. They had a typical jaw construction and teeth or rudiments of teeth in those jaws. They usually had external ears . . . and so on, down the list.

The next large group were the *Aves* or birds.

All birds were warm-blooded and their skins produced feathers instead of hairs. Even though in some few cases the feathers might look very much like hairs, their true nature could always be estab-



Platypus

(Drawing by Gustav Wolf)

lished by careful examination. All birds were tailless (except for pseudo-tails formed by long feathers), they had no external ears, no teeth in their jaws ever, they laid eggs, and did not suckle their young.

Next came the *Reptilia* (for a while thrown together with the *Amphibia*) which were no longer warm-blooded, and so on, and then came the *Pisces* or fish, which lived in water, were also not warm-blooded, and so on, and that ended the vertebrate animals.

This was Linnaeus's system and it was a good system. The trouble was merely that people took it too seriously and had to be taught to realize that it was not a natural law but merely a means for keeping order in the files. Platypus did the job of teaching that lesson.

When the first platypus skin reached England, the zoologists of the Royal Society were almost ready to declare that there was no such animal. At first glance it appeared to be merely a little mammal with four webbed feet, a flattened tail, and fur that was deep umber brown on the back and sides and paler on the under parts, as is quite common in small mammals. It was the head that was unbelievable. It looked like the head of a four-footed mammal, but instead of a mouth it had a bill like that of a bird. A bill like a duck's on a four-footed, fur-covered animal naturally attracted immediate attention.

The task of writing the first scientific description fell to Dr. George Shaw of the British Museum, where the original skin, which is said to be still preserved, was received in 1798. Shaw's description was published in the tenth volume of *Naturalists' Miscellany* (1799), at that time one of the important scientific journals. Since Dr. Shaw had only the skin, the description was naturally far from complete. But it settled the first question that had arisen: whether the animal existed at all. Certain scientists who had seen the skin had declared it to be a fake, an imposture, a product of art—in short, a Jenny Haniver. Shaw had to assert solemnly that it was real.

> Of all the Mammalia yet known, it seems the most extraordinary in its conformation, exhibiting the perfect resemblance of the beak of a Duck engrafted on the head of a quadruped. So accurate is this similitude, that, at first view, it naturally excited the idea of some deceptive preparation by artificial means; the very epidermis, proportion, serratures, manner of opening, and other particulars is the beak of a shoveler, or other broad-billed species of duck, presenting themselves to the view; nor is it without the most minute and rigid examination that we can persuade ourselves of its being the real beak or snout of a quadruped.

In spite of Shaw's description and another description by the German anatomist Blumenbach, which followed in 1801, doubts must have lingered, for in 1823 Robert Knox still felt obliged to defend the real existence of the platypus.

> It is well known that the specimens of this very extraordinary animal first brought to Europe were considered by many as impositions. They reached England by vessels which had navigated the Indian seas, a circumstance in itself sufficient to rouse the suspicions of the scientific naturalist, aware of the monstrous impostures which the artful Chinese had so frequently practiced on European adventurers; in short, the scientific felt inclined to class this rare production of nature with eastern mermaids and other works of art.

The "eastern mermaids" he mentions were examples of Chinese "art," frequently brought to Europe in those times. They consisted of the forepart of a monkey carefully sewn to the hindpart of a fish and dried so skillfully that it was hard to find the seam.

Following the rules of the game, Shaw had to give a scientific name

to the creature he had been the first to describe. He termed it *Platypus anatinus* ("the flat-footed animal with the duckbill"). Thus began the second controversy. Professor Blumenbach of Göttingen, in writing the second scientific description, christened the animal *Ornithorhynchus* (the bird-beaked animal), and added *paradoxus* as the second name because of the creature's paradoxical characteristics. Shaw's name was given earlier, but *Platypus* as a generic was no longer permissible, for it had been used still earlier (in 1793) by the German scientist Herbst for a genus of small beetles. Therefore, Blumenbach's *Ornithorhynchus* was established; but his second name *paradoxus* was not permissible either, since Shaw's *anatinus* was older. So the two names merged into *Ornithorhynchus anatinus;* but "platypus," "duckbill," and "water-mole" have survived in the vernacular.

With its existence and its scientific name established, the next question to arise was how to classify it, and it was this question that gave the platypus the reputation of being Zoological Nuisance No. 1. Some of this stigma still attaches to it.

Meanwhile, another specimen of platypus had arrived, this time not only a skin, but the complete female animal preserved in alcohol. It was carefully examined, and another astonishing discovery was made. Platypus, which in spite of its beak looked so obviously mammalian, had no mammary glands to provide nourishment for its young; and it had no normal mammalian genitalia, but instead exhibited a common excretory cavity or cloaca, a characteristic of birds and reptiles.

To make matters worse, about this time a relative of platypus was discovered. This was the echidna, also called "native porcupine" and "spiny anteater." While in outer appearance this animal *(Tachyglossus*[1] *aculeatus)* differed very much from the platypus and resembled more a small porcupine with perhaps a mixture of pangolin (scaly anteater), it nevertheless exhibited many of the platypus's characteristics. Its snout, for instance, was also like the bill of a bird, though to a lesser extent.

Dr. Shaw, in his first scientific descriptions, had suggested placing platypus with the lowest order of the class of mammals. Linnaeus had called his lowest mammalian order *Bruta;* and he had put into it what-

[1] Meaning "swift-tongue."

ever did not fit anywhere else. Later the name *Bruta* was changed to Edentata ("the toothless"), since all the heterogeneous animals assembled in this order were found to be distinguished by a complete or at least comparative lack of teeth even in the adult stage. Obviously, said Shaw, the duckbill platypus belongs to this order: not a trace of teeth is to be found in its mouth. This was not absolutely true, but the discoveries came slowly.

Shaw's colleague, Home, who had also pondered the second specimen in its alcohol bottle, was not so fully convinced. "Make a new order of animals out of these two," he suggested, influenced in his decision mainly by echidna. This was in 1803. One year later, temperamental Etienne Geoffroy Saint-Hilaire in France created the new order and called it *Monotremata* ("the single-holed animals"), but whether it should be an order of the class reptiles or of the class mammals he did not at first say. The German Tiedemann (1808) cautiously avoided the difficulties by placing platypus in an appendix. That was clever, no doubt, but it obviously was no solution.

The great Lamarck in France was apparently the first to suggest a new *class* for platypus and echidna, equal in rank with the great classes of birds, mammals, reptiles, and fish.[1] The designation he suggested for this class was *Prototheria,* a name that might be translated as "premammals." Mr. Illiger, another respectable and distinguished zoologist, agreed in general with Lamarck, but not with his name for the new class. He wanted to call it *Reptantia,* meaning something like "almost-reptiles."

In the course of this interesting debate, one still unanswered question of fact gradually became the main issue of the controversy: How did these two Australian nuisances reproduce? There were persistent reports from Australia that platypus laid eggs. Sir John Jamison wrote as early as March 1817 that "the female is oviparous [egg-bearing], and lives in burrows in the ground." We know now that this is true, but Sir John did not furnish evidence, and so it happened that the matter remained open to doubt for another half-century or more.

[1] The amphibians, intermediate between the reptiles and fishes, and including the frogs, toads, newts, salamanders, etc., were not regarded as an independent class till later. The carving of this class out of Linnaeus's class of reptiles was regarded as a refinement, not a contradiction, of his system.

The French author R. P. Lesson summed up the general feeling when, as a firm believer that platypus laid eggs, he wrote that these animals were "creatures set across the path of the scientific method to show its worthlessness."

Matters became still more complicated in 1824 when Professor Meckel in Germany discovered the mammary glands. They had been overlooked, and we know now that they are very much reduced except in the breeding period. One might think that such a discovery would settle the argument of classification once and for all by making it necessary to class the disputed animal as a mammal, for, as the name indicates, the possession of mammary glands is a primary distinction of mammals. But it did not, because these mammary glands were very primitive, being, as Meckel expressed it, "merely composed of a considerable number of ampullae [membranous sacs] with long necks." The necks of the ampullae did not end in teats, but in a great number of large pores on a small area of the skin.

On the contrary, these glands posed another enigma and led to a further controversy that lasted for many years. On one side there were the Saint-Hilaires, father and son, in France, supported by the Frenchman Latreille and the Dutchman van der Hoeven; while the German Meckel and the Frenchmen Blainville and Cuvier were the antagonists. The Saint-Hilaires did not welcome the discovery of the milk glands, knowing that their existence would be unfavorable to their contention that the monotremes were not mammals. Their reasoning was that "in spite of fur, limbs, lungs, and a heart with two ventricles," the monotremes were not mammals, because they laid eggs, had no true mammary glands, and had a cloaca. But they argued that they were not birds, either, having neither feathers nor wings. Neither were they reptiles, for they showed mammalian features and warm blood and lungs enclosed in pleurae. In short, they were monotremes. "We may today regard it as certain," wrote Geoffroy Saint-Hilaire *fils,* "that the . . . vertebrate animals should henceforth be divided into the five following types: mammals, monotremes, birds, reptiles, and fishes." Meckel's mammary glands had to be explained away somehow, and the Saint-Hilaires therefore declared these organs to be scent glands.

If they were milk glands, they asked, how were the young ones expected to suck milk with their horny beaks from a gland that did not even have a teat?

The question whether platypus actually laid eggs resulted in no less than three scientific parties, each defending firmly—*very* firmly—a different opinion about the method of reproduction. Meckel, Cuvier, Oken, and Blainville, all great names in science, argued that platypus was a mammal and therefore held that it must be viviparous, that is to say that it brought forth living young. The Saint-Hilaires and Blumenbach were convinced that it was egg-laying, or oviparous; while Home and Richard Owen believed that it must produce eggs, which, however, hatched within the parent's body, thus making the animal ovoviviparous. "The sad story of the eggs," as the Australian scientist Dr. Harry Burrell, top-ranking expert on the platypus, expressed it, began in 1829. In that year Etienne Geoffroy Saint-Hilaire triumphantly published a letter from a Mr. Robert E. Grant who reported the discovery of four *Ornithorhynchus* eggs. But a great disappointment was in store. The eggs were a bit large and in the drawing that was published they were so well reproduced that experts could classify them as having been laid by *Chelodina longicollis,* the common long-necked Australian tortoise.

The next name to be mentioned in connection with the eggs of platypus is that of Lieutenant Maule. In the years 1831 and 1832 he established the fact that Meckel's glands actually produced milk. He also reported finding eggshells in the nesting burrows, but this was not considered sufficient evidence, for these might not be platypus eggs. The next report that reached Europe came from one Jno. Nicholson, M.D., in a letter sent from Wood's Point, Victoria, Australia, dated September 21, 1864, and addressed to Richard Owen:

> Sir,—I have great pleasure in being able to inform you of a very interesting discovery in the anatomy of the *Ornithorhynchus paradoxus,* and one which I have no doubt you will hail with delight. About ten months ago, a female Platypus was captured in the River Goulbourn by some workman who gave it to the Gold-Receiver of his district. He, to prevent its escape, tied a cord to its leg and put it into a gin-case, where it remained

during the night. The next morning, when he came to look at it, he found that it had laid two eggs. They were about the size of a crow's egg, and were white, soft and compressible, being without shell or anything approaching to a calcareous covering.

Dr. Nicholson failed to examine the eggs closely, but though the size mentioned in his letter is exaggerated, they certainly were platypus eggs. Owen, belonging to the party that believed the platypus to be ovoviviparous, did not doubt the statement, but he declared that the egg-laying was not normal, and had to be regarded as an "abortion due to fear." It was this tenacity of these foremost scientists of their day in clinging to their preconceived opinions that made the controversy lively and lasting.

Owen's attitude, however, was not really unreasonable. The English zoologist Bennett had made a trip to Australia in 1832 and had tried to settle the great question once and for all. Dozens of nesting burrows had been uncovered and young platypi in all stages of development had been found. The milk production, established already one year before by Maule, had been confirmed, but no egg was found, not even a shell. Nevertheless, since it is a fact that platypus lays eggs, Bennett must have arrived just a few days too late.

The matter was finally settled by the independent discoveries of Dr. W. H. Caldwell of Australia and Professor Wilhelm Haacke of Germany. Curiously, these two men obtained the final proof for the oviparous habits of platypus and echidna almost simultaneously—Caldwell during the second week of August 1884, and Haacke on August 25 of the same year. Haacke examined the pouch of a female specimen of echidna, and to his surprise he found an egg in it; his surprise was so great that he crushed it between his fingers. Another coincidence is that the discoveries that were made within a week of each other were reported by Haacke and Caldwell on the same day. They did not know about each other and afterwards it was difficult to decide to whom the priority belonged.

It was the last salvo in the great battle. Platypus was well established. It laid eggs, but it put them into a pouch. It fed its young with milk, but it had no teats. It had—another little item that had not been easy to establish—warm blood, but of a much lower temperature than all other

mammals. It was in general either a reptile with many mammalian features, or a mammal with many reptilian habits. It was something between reptile and mammal: Lamarck's name *Prototheria* (pre-mammals) had been strikingly good. Why platypus and echidna represented such an unbelievable mixture of reptilian and mammalian features could be explained only by Darwin and his followers. Here was a survivor from a former geological period, possibly from the time when mammals evolved from reptilian ancestors. As soon as the smoke of battle had cleared away, this simple (and only) explanation became perfectly obvious.

But I have not yet told the whole story of platypus. In 1891-92 a German professor, Richard Semon, made a trip to Australia in pursuit of the lungfish *Ceratodus* (which will be the subject of the next chapter), and while waiting about a few weeks for his fish to lay their eggs, he made some observations on the two monotremes, mainly the echidna. Thanks to Caldwell, Semon, and Dr. Burrell, we now have a fairly good knowledge of platypus and echidna. The facts are as follows:

The monotremes live on the Australian continent, in Tasmania, and in New Guinea (also in the better zoological gardens). All monotremes lay eggs, but platypus differs from echidna in that its pouch is too small to hold the eggs and they are hatched in a sort of nest. It lays two eggs at a time, each three-fourths of a inch long and one-half inch wide, enclosed in a strong, flexible, white shell. The young are nourished on the secretion of the rudimentary mammary glands, contrary to the contention of the Saint-Hilaires and in spite of the apparently impracticable beak possessed by the adult. Observation has shown that the young of echidna are carried around in the pouch until they are almost one-third grown. The natural diet of echidna consists of ants and other small insects, while platypus feeds on insects, worms, and small crustaceans. In captivity one platypus ate half a pound of earthworms, forty shrimps, and forty grubs in one day! Platypus has cheek-pouches, but apparently does not use them for storing food.

There are still a number of open questions. For example, the duration of life is still unknown; so is the exact utility of the beak of platypus and the reason why this strange organ has been evolved. It is not

as hard and horny as dried museum specimens would indicate, but is soft, like rubber, and extremely sensitive. Burrell believes that it serves as an ultrasensitive organ for feeling the way under water where eyes and ears are shut.

But the greatest of the unsolved mysteries is the movable spur, like a cock's, on the hind legs of the males of platypus and echidna. It has a canal, so thin that a horse hair does not pass through it, though a human hair does, and is connected with the duct of a gland. The spur was always reported to inflict poisonous wounds. Sir John Jamison wrote in 1816 that a man, in spite of immediate medical treatment, "exhibited all the symptoms of a person bitten by a venomous snake." The victim "was obliged to keep his bed for several days, and did not recover the perfect use of his hand for nine weeks." Since then many scientists have experienced or seen wounds inflicted by the spurs; the wounds are described as extremely painful, but not fatal. Rabbits injured by the spur did, however, die.

Since the spur is attributed only to the males it can hardly be regarded as a weapon. The French scientists agreed that it served to hold the female during copulation, but others refused to find this explanation adequate. Another theory occasionally advanced is that the spur is to inject a "drug" into the blood of the female to minimize her resistance. Burrell believes that the spur serves as a paralyzing weapon in the fights of the males for the possession of the females. Obviously, it is not the aim of these fights to kill, though fatal effects have been observed.

And the result of the fiercest of all the battles around platypus: how should the monotremes be classed? They have become a subclass of the mammals, the lowest subclass. Here they stand closest to the reptiles, with which they share the cloaca, the habit of laying eggs, and the low blood temperature, which is between five and twelve degrees centigrade lower than that of man. Yet, truth to tell, this classification is still somewhat problematic. It was attacked again some thirty years ago.

I have said that platypus and its cousins are survivors from a former geological period. Where then are the fossil platypi? They were finally found, though not at once recognized. Near Echterdingen in Württem-

berg, Germany, almost at the place where one of Count Zeppelin's first dirigibles was later to meet a sudden and tragic end, a number of tiny fossil teeth were discovered in 1874. It was assumed that these teeth had belonged to some mammal, and the name given this unknown creature was *Microlestes*. How *Microlestes* looked could not be said; only its teeth were known. Its size must have averaged that of a rat. But there are many mammals the size of a rat that are very different in appearance.

Then one day it was found that platypus develops teeth for a short period during early life. They are soon lost, but they show a surprisingly close resemblance to the teeth of *Microlestes*. Probably *Microlestes* was an extinct monotreme. Then when several other extinct little monotremes were found, it was suggested that the animals of this type, extinct and living, be brought together into a new class called *Allotheria* (meaning simply "other mammals"). However, the suggestion was not cheered by the majority of scientists. Apparently they were pretty tired of questions of classification, as far as monotremes were concerned, and the monotremes have remained a subclass of the mammals.

17: *The Lungfish That Made History*

AFTER the significance of platypus had been recognized, the continent of Australia acquired a very special glamour in the eyes of every evolutionist. The existence of platypus was proof, among other things, that Cuvier's world-wide cataclysms were a figment of imagination, else there could be no "living fossil." And platypus was not the only piece of evidence. Most of the other animals from the Fifth Continent, in fact all of them, except the Australian aboriginal "blackfellow" and the wild Australian dog, the dingo, were living fossils. They were all marsupials, and marsupials do not really belong to our time. No wonder the evolutionists seized upon the platypus country, the land *par excellence* of living fossils—Australia and some of the islands in its immediate vicinity, like Tasmania, New Zealand, and New Guinea—as the zoological "attic of our planet." Everything that had been discarded or at least forced into the darkest corners elsewhere apparently survived in or near Australia.

Small wonder, too, that European zoologists—American zoology was still in its early stages about a hundred years ago, and, besides, American zoologists were kept sufficiently busy with the animals of their own continent—began to look longingly in the general direction of the South Seas. This was a place where big and important discoveries were probably waiting to be made. There, in the romantic distance, where sea captains had once looked in vain for a fabulous Southern Continent with golden mountains and the Fountain of Life—there, far

from old and war-weary Europe—seemed to lie a scientific treasure island of undreamed proportions, the promised land of the biologist. If Australia had only been a little closer to home, the enthusiastic men of science would have undertaken a systematic search, but this was quite impossible. Thus it happened that the most important discovery after platypus was made accidentally.

Again it concerned one of Australia's strange living fossils, but this time of another class of animals. This time it was a fish, an extraordinary fish, with some very unfishlike features. The story of its discovery is as extraordinary as the fish itself.

An Australian squatter, William Forster by name, who had lived for a number of years on a farm near the Burnett River in Queensland, moved to Sydney in 1869 to settle there. One fine day, looking over the city that was to be his home, he visited the Sydney Museum. There he met the curator of the museum, Gerard Krefft, and they fell into a conversation about Australia's unusual animals. Forster asked quite casually why the museum failed to exhibit a certain big fish from the Burnett River. The curator was not quite certain whether he had properly understood the question.

"Which big fish?" he asked.

"Well, the farmers around there call him the Burnett salmon or something like that," Forster replied, "and the blacks call him *barramundi* or *barramunda*."

Krefft was not familiar with either of these names, and it is also likely that his ideas about the location of the Burnett River were not too exact. He asked for a more detailed description. Forster did his best to describe the fish: it was about five feet long when fully grown, something like a very fat eel, but with large greenish scales and four—yes, only four, he was positive—strong fins. Forster said he had actually seen and caught it more than once. Krefft had never heard of such a fish, and it was probable that neither had any other scientist. He told Forster that this might be a creature new to science and asked whether he knew of a way to obtain a specimen, or several, for the museum.

"Of course," Forster agreed, "that can easily be done. My cousin is still living on that farm; I'll write him for a few Burnett salmon."

A few weeks later a barrel arrived at the museum direct from For-

ster's cousin's farm near the Burnett River. It contained not one but several fish, strongly salted so that the heat should not destroy what might be a boon to science. Krefft winced a bit at the method of "preservation" but he examined the contents of the barrel with great curiosity.

It was a big variety of fish, so much was sure. Mr. Forster's description had been as accurate as could be expected. The fish was about five feet long, greenish in color on top, whitish underneath, and had unusually large scales. It had four—yes, only four—strong fins, and possessed a very unusual type of tail: not the proverbial forked fishtail nor yet a tail like a shark's, but something that is hard to describe but easy to remember once seen. In scientific parlance it goes under the name of diphyceral tail, and it consists simply of a rim of fin material around the rear end of the body. There was no dorsal fin, and the four fins present looked more like paddles than the fins of any other fish then known.

In the case of platypus the teeth had been the last surprise. In the case of the "Burnett salmon" they were the first significant surprise. Krefft, after noting the general appearance of the fish and its queer tail and extraordinary fins with little more than normal scientific curiosity, opened the mouth of the latest acquisition of his museum. He had to sit down for a moment to regain a badly disturbed mental equilibrium. The big teeth, of which there were only four in the mouth of the fish, were already known to science.

Large fossil teeth of this type had been found in ancient rock deposits —ancient even in the language of the geologist, who pays little attention to a discrepancy of a million years more or less—and they had caused some perplexity among paleontologists. They were certainly the teeth of a fish, but of what kind could not be said. They looked as if they were a full set of teeth grown together, their general shape having much resemblance to the comb of a rooster. There was nothing similar in any living fish; it must have been a species that had become completely extinct.

For a while it was believed that some extinct variety of shark might have grown them. Then it seemed more probable that they were the dental apparatus of an extinct fish that was perhaps related to the stur-

geon, which, unfortunately, has no teeth at all. Professor Agassiz, the great authority on extinct fish, had christened the unknown owner of these teeth *Ceratodus,* meaning "the horn-toothed." How the fish *Ceratodus* looked, no one dared guess.

Now Gerard Krefft, curator of the Museum of Sydney, saw before him exact replicas of the mysterious fossil teeth that had baffled much better men than himself. And he was most fortunate in having not only the teeth of the fish *Ceratodus,* but the animal itself. The specimens on his table were dead, but not fossil; they had been killed only a week or so before. Probably there were many more of them in that Burnett River, of which he did not know much more than the name.

Krefft was soon aware that these animals on his table were *Old;* old with a capital O. "Old as *Latimeria*" he might have said, if he could have known of *Latimeria.* These fish were older than the dinosaurs, about as old, indeed, as the Australian continent itself. They were survivors from the Middle Ages of fish history.

They were of a very primitive type, without the forked tail that is so obvious a feature of modern fishes and without real fins. Instead they had strange paddlelike appendages which told a long story in themselves. As a matter of fact these fins had, so to speak, been prophesied.

And now it becomes necessary to go into the background of that prophecy. Linnaeus, you remember, had done the great service to science to produce a complete catalogue of all the living things known in his time, neatly arranged as to anatomical characteristics and beautifully labeled with Latin-Greek double names so that there could be no linguistic confusion. That this method really works is something I have experienced myself; I learned the English names of animals by going through the Bronx Park Zoo and identifying the name plates either by identifying the animal in the cage, or by identifying its Latin name. The latter was the more reliable method, since animals are often asleep or hiding.

But this same Linnaeus had stated categorically, for reasons best known to him, that the species were unchangeable. It was merely a personal belief, but since it had come from such an important man it was uncritically accepted and it needed Darwin to break it down.

But once you had the idea that species could change and in all probability had changed, you also wanted to find out what had changed into what and when. Thus the "ancestral trees" originated, and an early specialist in this field was Professor Ernst Haeckel in Jena in Germany. But there were some difficulties. After all, the knowledge of fossils was young, the great American fossil beds were still mostly undiscovered. Trying to establish an ancestral tree was very much like trying to fit a jigsaw puzzle of which most of the pieces were missing.

Since we know the ancestral tree of the horse quite well from an earlier chapter, it may serve as an example for the procedure. There were all the present-day horses: the domesticated horse, the zebras of Africa, the donkeys, the wild asses of India. (The real wild horse of Asia was still unknown.) Now it was obvious that the zebra had not evolved from the horse, and the donkey had not evolved from the zebra. They all had to go back to a number of common ancestors and finally to *a* common ancestor. There were some Hipparion bones around, obviously an ancestor. (Actually it was an old side line, but that was not known then.) Going back more and more in time, there must have been an ancestor of all horses and horselike animals. We know it now—*Eohippus*—but if *Eohippus* were not known we would still know that there must have been such an animal. We would notice a hole in the jigsaw puzzle and to a reasonable extent we could deduce the size and shape of the missing piece. And we could just write "dawn horse" in that empty space, hoping that one day it might be found.

This is precisely what Haeckel did. And he was aided by a rule which goes under the name of biogenetic rule or recapitulation theory. It states that the growth and development of the individual embryo before birth repeats, in an abbreviated, often simplified, form and in a tremendously quickened sequence the long evolution of the species to which it belongs. It is, figuratively speaking, as if the embryo which belongs to species 47 at birth has to count fast from 1 to 46 in order to reach 47. That this is so, with only a very few and for the whole scheme unimportant exceptions, is of course a great help.

No wonder that Haeckel became almost obsessed with this rule. He was not its discoverer, as most people believed for many years, but he forcefully introduced it into scientific practice and he made it so widely

popular that for decades every schoolboy in Europe (and I mean that literally) knew his formula by heart: "Ontogenesis recapitulates phylogenesis"—ontogenesis being the individual development and phylogenesis the development of the whole species.

One of the missing pieces of the puzzle at that time was the ancestor of all the animals with vertebrae which inhabit the land. It was certain that the vertebrate animals had evolved in the seas. They started as fishes, and from the fishes sprang the amphibians (frogs, toads, newts, and salamanders), the reptiles (turtles, lizards, snakes, dinosaurs), the birds (from the penguin to the thrush) and the mammals (from the housemouse to the owner of the house). In Haeckel's day it was believed, also by Haeckel himself, that the amphibians had come from the fishes, the reptiles from the amphibians, and both the birds and the mammals from the reptiles. Now we incline to the thought that the amphibians sprang from the fishes, the reptiles *and the mammals* (separately) from the amphibians, and the birds from the reptiles. But for the main question this difference of opinion was unimportant, because that main question concerned the transition from the fishes to the first land animals, the amphibians.

There must have been something connecting the two. There must have been a group of animals that were neither fish nor amphibian or, rather, that were no longer fish and not yet quite amphibian. Most probably these animals were extinct. Possibly their fossil skeletons might never be found. But, equally possibly, they might still be discovered alive. The platypus, evidently an animal from the time when reptiles, amphibians, and mammals were not as distinct from each other as they are now, gave some hope of this—not much hope, to be sure, but just enough to keep it from being jeered at as "wishful thinking."

When scientists tried to imagine how the link between fish and amphibians might have looked, they agreed on picturing a creature of generally fishlike appearance. Also of necessity this animal must have had a double respiratory system: gills for breathing in water and lungs for breathing in air. The real difficulties started when it was sought to visualize its limbs. These limbs must, in essence, have been the fins of a fish, but fins so modified that they were ready to change further, into legs. Such limbs may seem easy to imagine, but they offered a very

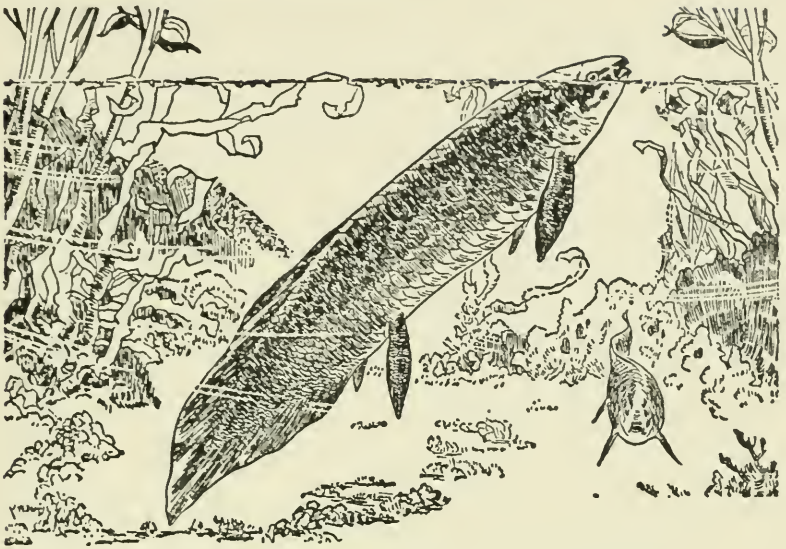
difficult problem to the experts. Anatomists looked at the pectoral fins of fish and gravely shook their heads; from these fins there could never have developed anything remotely resembling the leg of a salamander. It simply was not possible, no matter what intermediary modifications were assumed.

The evolutionists were annoyed. Then Karl Gegenbaur, a German disciple of Darwin and Haeckel, and an anatomist who has hardly ever been surpassed since, proposed a solution that brings us back to the lungfish. The reason, he said, that we have not been able to establish a connection between the fins of the fish and the legs of the salamander is that we have put the question wrongly. The fin of the modern fish is itself the product of extreme adaptation and specialization. The modifications it has undergone must be traced back to some more primitive form that could have developed into either a fin or a leg. It was again a case—an earlier one in the history of zoology—of the simple crowbar that can be used roughly for many purposes and the complicated machinery made out of it that can be used for one purpose only.

In short, Gegenbaur advised looking about for a very primitive fin which would be the "missing link" between the highly specialized modern fins and the equally specialized amphibian's leg. When it was not found, he "invented" one. He drew a skeleton of a fin that resembled a fern leaf and named it *Archipterygium gegenbauri* ("Gegenbaur's archaic flipper"). There was again the hope that it might be found in a fossil state, attached to the skeleton of a primitive fish of very ancient times. That was why each and every one of the four strong paddle-like fins of Mr. Krefft's new fish from the Burnett River was a very special birthday present for Professor Gegenbaur. They were exactly what he had looked for and had had to invent: primitive fins not yet too specialized for new tricks of evolution.

Krefft must have been in a high state of scientific excitement when he began to dissect his fish. Though he had not been following the discussions in far-away Europe very closely, he must have known that the evolutionists expected the missing link between fish and amphibians to have both gills and lungs. His big "Burnett salmon" of course had gills; did it have a lung too? It did! And only a single lung at that.

I shall have to digress again in order to explain why it was the single



Australian lungfish (*Neoceratodus forsteri* Krefft)
(Drawing by Joseph M. Guerry, courtesy *Natural History Magazine*)

lung that was the most exciting part of this discovery. It happened that two different lungfish were already known. The first had been discovered in South America in 1833 by the Austrian collector Johann Natterer. It looked like a fat eel, was about two feet long, and exhibited, besides its gills, a pair of fully functioning lungs. The natives called the creature *caramuru;* Natterer gave it the scientific name *Lepidosiren.* The second lungfish had been found a few years later in the White Nile in Africa. It looked very much like *Lepidosiren.* The native name was *comtok;* the scientific name *Protopterus.*

Both these animals had caused some annoyance among zoologists before Darwin's time, for, though they chiefly resembled fish, if they were placed among the latter in the Linnaean system it was hard to see what then distinguished amphibians from fish. Their lungs, according to the old criterion, placed them in a class above fish; but their scales put them in a class below amphibians. Nor could they be classified with the scaly reptiles, since lungfish also had gills.

These two types of lungfish had been regarded as scientific curiosities for other reasons. Neither of them had real fins; and they displayed that ancient type of unforked tail that had not yet developed to any appreciable size. Their method of locomotion was even more eel-like than their bodies, and their fins (whatever they may have looked like originally) had atrophied from disuse into thin and almost string-like appendages. During the dry season both types curled up and went to sleep in a round mud cake which dried as hard as stone and could be mailed without disturbing the fishes' slumber. All the addressee had to do when the package arrived was to place the apparent stone in a bathtub of lukewarm water, and after a few minutes the mud cake would dissolve and a very much alive lungfish would emerge from the dirt.

These habits of the lungfish made a very interesting story for natural history books; but from the point of view of the evolutionists they were not of much importance beyond illustrating the fact that these animals had changed a good deal since they crawled in the swamps of the beginning of the Carboniferous Period. The case was similar to that of the platypus's bill. This organ, which had caused most of the first astonishment and all the original doubt, was of no significance whatever in the eyes of the evolutionist. It was the platypus's milk glands that were important, and the platypus's eggs. So it was the lungs of these lungfish that were important, not their mud cakes. But the other archaic features that evolutionists were looking for were practically missing.

When Gerard Krefft discovered the single lung of his new fish, he realized that this was the "true" lungfish, the more primitive type—the original, as it were. And since its teeth were so very similar to the fossil teeth for the possessor of which the great Agassiz had already invented the name *Ceratodus,* Krefft chose for the name of his lungfish *Ceratodus forsteri* Krefft. The common name, however, became Australian lungfish, since the other two types were already called the South American lungfish and the African lungfish. It may seem that the common name is the more descriptive of the two, but it must be borne in mind that the teeth of *Ceratodus* ("the horn-toothed") are its most distinguishing feature. There are three fish known to have lungs, but there is only one fish with archaic teeth like *Ceratodus.*

Later, complete skeletons of the original fossil *Ceratodus* were found,

and since it was then discovered that there were a few minor differences, some authors suggested changing the name of the living *Ceratodus*. The most obvious change consisted in placing the Latin word *neo* (new) in front of the name so that it became *Neoceratodus;* but *Epiceratodus* ("after *Ceratodus*") has also been used.

All in all, the new fish was a great discovery—a fish that could be traced back four hundred million years to remote geological periods, a fish with a primitive tail, a primitive skeleton, primitive fins, and, in addition to all this, a single lung! It was pure honey to the evolutionists and pure poison to those who still adhered to the older ideas of the biological world before Darwin. And Herr Geheimrat Professor Dr. Ernst von Haeckel, who sat in his studio in quaint old Jena in the center of Germany, did not hesitate to attach the highest scientific significance to the new animal from Australia.

Only one thing, he felt, was lacking: the "ontogenesis," the individual development, of *Ceratodus* was not known. Even the new zoology texts yielded little information. The Australian lungfish, they said, the so-called barramundi, lives in Queensland, in brackish water; it feeds on water plants, and buries itself in the mud during the hot and dry months of the year. The latter fact was not really known, but it applied to the two other lungfish and was believed to be true also of *Ceratodus*. It was known with certainty, however, that *Ceratodus* laid eggs, and that was the point where research would have to be begun.

One of Haeckel's pupils, Professor Richard Semon, was willing to make a special trip to Australia to investigate *Ceratodus;* and Paul von Ritter, a manufacturer in Basle, Switzerland, who had often donated large sums of money for Haeckel's scientific work, was willing to pay the expenses of the expedition. So Semon set out for Australia to hunt *Ceratodus,* in order to study its development from the egg.

In August 1891 he arrived in the "attic of the world." The books said that the lungfish preferred brackish water, and Semon therefore reasoned that it would most probably be found where the Burnett and Mary rivers flowed into the Pacific Ocean near the city of Maryborough. Consequently he went to Maryborough, hoping for brackish water teeming with *Ceratodus*. Maryborough was a pleasant, progressive city, complete with Salvation Army and all, but no lungfish. Semon reported

home that the books were wrong; *Ceratodus* lives only in fresh water. He had to go inland to find it, and his next stop was the little village of Gayndah on the Burnett River. This place was somewhat more promising from a zoological point of view: a specimen of *Ceratodus* had even been caught recently. But better opportunities lay beyond; and, besides, Semon was anxious to escape from well-meaning but bothersome reporters and from the other guests of the Gayndah Club Hotel. So he went still farther inland.

Ten years earlier an Australian scientist, Dr. Caldwell (the same who discovered that the platypus lays eggs), had tried to investigate the development of the lungfish. He had not been successful, but he had announced that the eggs of *Ceratodus* were laid on water plants. This was about the only true thing published on the life habits of the Australian lungfish. Semon was to find out that all that Krefft had published—aside from the fairly correct anatomical description—was wrong. *Ceratodus* lived only in fresh water, in the Burnett and Mary rivers; it did not feed on plants, but on small animals of all kinds; and it did not go into estivation, as the sleep in a mud cake is called. Eventually it was discovered that even the name barramundi was wrong: the native word for the fish was *dyelleh*.

While Semon was busy hunting *Ceratodus* eggs, a visitor arrived: Professor Spencer, biologist from Melbourne, spending his vacation on research. Object: the evolution of *Ceratodus!* The two scientists shook hands and tried to work together—but without success. There was nothing to work on, no *Ceratodus* eggs. Eventually Professor Spencer's vacation ended and he had to return to Melbourne. Semon managed without much trouble to conceal his unhappiness over Spencer's departure.

A full month later three eggs were found. Semon at once ordered a thorough investigation of every plant in the river. The first day brought twenty-three eggs. Then for several days new material continued to come in, and the real job began: that of watching the development of the embryos in the eggs and putting them in alcohol at the right time in order to have a series of preserved specimens in all stages of development. But soon the supply of fresh material ceased. Semon quickly discovered the reason for this interruption of his work. Though he had

strictly forbidden it, the natives had been catching *Ceratodus* to eat, and the one female fish that had produced all the eggs had also become a victim of native appetite.

This little accident delayed the work for a whole year. One morning Professor Semon found himself alone; the natives had left their jobs without giving notice. They disliked being bawled out in defective English and had their own ideas about "discipline." Then the rainy season began. The time at Semon's disposal was three-quarters gone. He went to Thursday Island, halfway between Australia and New Zealand, where there were a few zoological observations of lesser importance to be made. In the main task he had failed. What was to be done? Go home with very little to show? Or wait for the next opportunity, which would be September of the following year?

Semon decided to wait. Cables from Europe assured him that his vacation would be extended for this purpose. Money followed. In July of the following year, he returned to Gayndah and hired other natives, who to his surprised delight eagerly followed his orders and left *Ceratodus* alone. Semon was offering premiums for the eggs, even though the lucky finder would usually be too drunk to report for work for a week after receiving his pay. When it seemed to him that precious time was passing, he frantically raised the premium: twenty-five dollars for the first eggs, *if* you promise not to eat or kill any fish, and keep the promise.

On September 16, 1892, the first eggs were brought in. Luck was good that year: all in all about seven hundred eggs were found. The hatching and breeding presented no difficulties; but after a while it became evident that the growth of the young fish was too slow for the amount of time that was still at Semon's disposal. He had to think about going home. Friends and colleagues promised to care for the young and to embalm specimens in alcohol at the various stages of development.

Once again specimens of *Ceratodus* were shipped to a museum in kegs and barrels, but this time the museum was in Jena, and the young specimens were preserved in a scientific way. Semon was able now to work out his observations and notes and studies, and did so with classic German thoroughness. All the important facts on the development of this fish, from the egg to the adult stage, are contained in Semon's

work, and if a great drought in Queensland were to bring the Australian lungfish to extinction, it would now, from a purely scientific point of view, be a bearable loss. Later, the evolution of *Ceratodus* through the various geological periods became known through the work of Louis Dollo and others.

Forster's "big fish from the Burnett River" was really one of the great zoological finds of the last century. It represented the purest type of the original lungfish, while *Lepidosiren* and *Protopterus* had changed considerably in the intervening period of more than four hundred million years. *Ceratodus* exhibits features which indicate a common ancestry with the amphibians, which were the first vertebrate animals to live on land; and in certain respects it resembles the salamander. Though the Australian lungfish is not directly ancestral to the amphibians, it is an ancient form that has evolved in their direction.

This was the most important result of Semon's Australian expedition. The other facts revealed about *Ceratodus* were mostly corrections of the wrong notions that had found their way into all natural history books from the first narratives. Only one other thing about the lungfish need be amplified. *Ceratodus,* with its simple lung, which is somewhat less developed than the paired lungs of the other two types of lungfish, cannot live on land as has been claimed. (Incidentally, its paddlelike fins are unfit for crawling, though the fish stands on them under water as if they were legs.) It is essential that its gills be kept wet. When in the Australian summer the rivers evaporate until only a chain of small lakes and puddles is left, and all the inhabitants of the water are collected in them, *Ceratodus* is able to survive. Many of the true fish die in these periods, because the water soon becomes foul. *Ceratodus,* however, needs only moisture on its gills, no matter how small the oxygen content, and then it is able to breathe atmospheric air by means of its lung. In fact, even in aquariums, where the water is perfectly fresh and rich in oxygen, *Ceratodus* comes to the surface about every hour to renew the air in its single lung. This is done with a very peculiar gulping sound, a sound one may imagine to be as old as the fish itself. The giant dragonflies of the Carboniferous Period—measuring two feet and a half from wing tip to wing tip—may have heard this sound.

18: New Zealand Interlude

THE YEAR was A. D. 1642.

The place was the main office of the government of the Dutch East Indies.

The occasion was a conference under the chairmanship of the Governor of the Dutch East Indies, Mijnheer Antoon van Diemen.

And the outcome of the conference was that Captain Abel Janszoon Tasman was ordered to proceed with the good ship *Heemskirk* to the new and poorly known continental coast of Nieuw Holland and to sail south along its coast until such a time as he either could turn east or would be forced west by said coast.

Captain Tasman left from Batavia and sailed as ordered. The coast of Nieuw Holland—what we now call the West Coast of Australia—did not force him to turn west as had been expected. On the contrary, he could turn east after some time, and finally he saw what was unmistakably a southern cape. Tasman thought that it was the southern end of the vaguely known Australian continent and named the area of that southern cape Vandiemensland, in honor of the governor who had ordered this voyage of exploration.

Actually it was not even Australia proper any more; Tasman did not know of the existence of Bass Strait. It was the southern end of the large island now known, in *his* honor, as Tasmania.

But Tasman did not turn around then. His orders were to go on, if possible, and to find open sea to the east of Nieuw Holland, provided that there was an open sea, of course. Expressed in present-day language, he was simply ordered to sail around Australia; the problem then was,

however, whether that could be done. So Tasman kept the bow of the *Heemskirk* pointing east and went on for another thousand miles. And on December 16, 1642, he saw land again, "great, high, bold land." Although the Netherlands province of Zeeland is neither great, nor high, nor bold, to the view of the traveler approaching it, Tasman named the new land *Nieuw Zeeland*—and it has been New Zealand ever since.

Strangely enough, matters rested there for more than a century.

In November 1769 another vessel approached New Zealand, from the other side. It was the *Endeavour,* commanded by Captain James Cook. Captain Cook did land—Tasman had not attempted a landing, he was interested in the problem of where one could sail, the land was mostly an obstacle—and then came that interview with the Maori chief Tawaihura who told the visitor about the big man-eating lizard that never existed but did not say a word about the actual animals of New Zealand. One wonders whether he had really understood the request, or whether he perhaps adhered to that strange idea of "politeness" of so many native tribes which feel obliged to answer every question in the affirmative and consider it impudent to volunteer information not specifically asked of them.

If Captain Cook had not been misinformed so badly, his naturalist, Sir Joseph Banks, could have brought some very strange animals back to England. Conceivably they might still have seen a living moa, certainly they could have killed, or even caught, a kiwi. As it was, they came back almost empty-handed and New Zealand's strange survivors from past ages drifted into the hands of science piecemeal; we don't even know the dates precisely.

The first kiwi skin was sent to England some forty-five years after Captain Cook's visit by Captain Barclay of the ship *Providence.* Nobody knows whether the kiwi was known to somebody before that time, nobody is even quite sure where Captain Barclay's skin originated. The British naturalists who received it could only marvel at the strange arrival from the new colony.

It was a hen-sized bird, completely wingless and tailless as far as external appearance went, and with hairlike feathers almost belying the old and otherwise so reliable saying that one knows a bird by its feathers. It had enormous four-toed feet and a long snipelike bill with the

nostrils placed at the tip. All in all, it looked much more like a taxidermist's concoction than like a bona fide specimen, although there was no doubt as to its genuineness. If these scientists had also been told that this bird lays eggs weighing precisely one quarter of the weight of the adult specimen they would probably have disbelieved it—it *was* dis-

Kiwis (*Apteryx australis*)

(Drawing by Olga Ley)

believed for decades and some even went looking for a large bird that could have laid those eggs. The matter was not completely settled until caged kiwis in zoological parks were kind enough to demonstrate that those large eggs were really theirs.

The first examiner of the skin was Professor Latham, who, after long

hesitation, decided to call the bird an "apterous (wingless) penguin," but who cautiously said, at the same time, that this classification was just tentative. "The form of the foot," he wrote, "is not greatly unlike that of the dodo, and in the specimen the toes were not connected by an intervening membrane; yet from certain inequalities on the sides it is possible that there may have been one, and that it had been eaten away by insects."

The next zoologist in line, Shaw (the same who also had to struggle with platypus), gave it the name it bears today: *Apteryx,* or "wingless bird." That was all right, but the next after Shaw, Temminck, blundered badly. Influenced by the foot, he placed *Apteryx* the kiwi and *Didus* the dodo into the same "order," which he called *Inertes.* And that order he placed next to the order of the penguins. That way, if nothing else, at least confusion was complete!

Actually the dodo was a pigeon, the penguins are an order by themselves now but are the offspring of birds which once could fly. The New Zealand kiwi, however, belongs with the moas, and all of them are birds which probably never could fly. Or to which, in the course of evolution, the flying stage was a very short passing phase.

Most zoologists, while not yet aware of these connections, failed to fall in love with Temminck's cleverness and cast about for something better. In Germany the kiwi had meanwhile acquired a German name, *Schnepfenstrauss* or "snipe-ostrich," which at least pointed in the right direction. But for reasons nobody could explain afterward the snipe-ostrich was tacked on in back of the *Galliformes* or chickenlike birds, where it obdurately remained until after the end of the nineteenth century. And all this in spite of the fact that Yarrell in England had delivered a new description of kiwi in 1833 and had put the New Zealand kiwi, the Australian emu, the African ostrich, and the South American rhea or nandu into one large group. If he had known about the moas and about Aepyornis of Madagascar he would have put them into that group too. And that would have been correct. Because all these birds, while not very closely related nowadays, at least seem to converge into one old tribe of birds which had dispensed with flying at a very early time. Provided they ever did fly.

But let's talk about the living kiwi for a moment.

Actually one should say kiwis, because there are three varieties: *Apteryx mantelli* of the North Island, *Apteryx australis* of the South Island, and *Apteryx oweni* which occurs on both.[1] But they are so much alike in their habits that they can be treated as one.

To say that it is a noctural forest bird about exhausts the matter. In daytime the kiwis sleep huddled together and if awakened by force look fairly helpless. It is quite likely that sunlight will blind their eyes, which are adjusted for nocturnal activities. These are said to be quite noisy, the kiwis move about restlessly, hunting for earthworms and grubs and insects living on the ground. The guiding sense in these hunts seems to be the sense of smell; the kiwi is the only bird in which the sense of smell is developed at all—or maybe one should say, in which that sense has not been lost millions of years ago. When frightened the kiwis run in long strides and they can jump well.

It would be an interesting experiment to find out whether a kiwi can swim; the moas might still be alive if they had mastered the art of swimming. The Maoris said that they could not, and considering their shape that sounds logical. As regards the kiwi, I have not been able to find any statement about swimming anywhere. Nor have I come across a report which either proves or disproves the old tale that a solitary kiwi will sleep in a "three-legged" position, leaning on its bill.

Since the New Zealand government is taking good care of the living fossils of its land, the kiwi will be with us for some time to come and these questions might still be settled. More difficult is the problem as to just where the kiwi belongs in the evolutionary history of the birds. No doubt with the other wingless birds of the Southern Hemisphere, and especially with the moas. But just where could be decided only by finds of fossils which would permit tracing its lineage. That it is quite old among even the old flightless birds is obvious. In fact, it may turn out to be the oldest of the living birds, even if we include the moas among the living. No other bird still retains a sense of smell. And it is logical that the separation between the winged and the practically wingless birds

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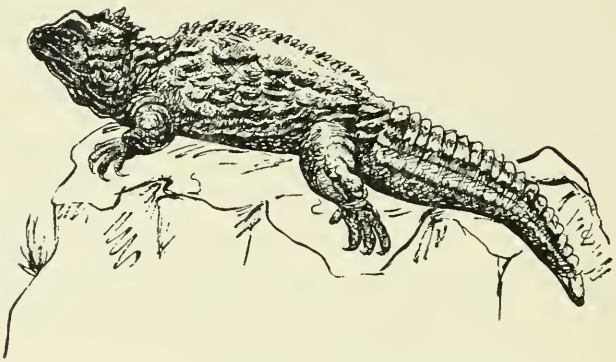
[1] There is also an undiscovered kiwi, *Apteryx maxima*, of which nothing is known but parts of its skin which formed part of a Maori chieftain's dress. It must have had the size of a big turkey; by now it is probably extinct. If more were known about it, it might be classified with the kiwilike moas of the type *Megalapteryx* (the word itself means Big-Kiwi, indicating the close relationship).



Lizard *Hatteria* or *Sphenodon,* from New Zealand
(Drawing by Olga Ley)

started with small forms like the kiwi. The large ones like the moas probably grew large later.

If the kiwi can be suspected of being one of the oldest wingless birds, another living fossil from the high bold land that Captain Tasman saw from a distance is known to be one of the oldest of its kind. I am speaking about the "lizard" *Hatteria* or *Sphenodon.*

Like the kiwi, it crept up on science slowly and unnoticed. Nobody knows who discovered it and when. It is true that it does not look too conspicuous to the untrained person. *Hatteria* has the general shape of a plumpish lizard. When fully grown it is from fifteen to eighteen inches long. It has a fairly short but heavy tail, a large head with big eyes, a loose skin of greenish color that looks as if it were too large for the animal inside, and a somewhat tattered crest of spines running along neck, back, and tail.

The Maoris called it *tuatera* or *tuatara;* the forms *ruatara* and *tuatete* are also on record. Dieffenbach stated in 1835 that his Maoris had called it *ngarara.* As scientific names *Hatteria punctata* and *Sphenodon punctatus* are both customary; Europeans usually prefer *Hatteria,* Americans *Sphenodon.* The latter means "the spiny one with wedge-shaped teeth." Richard Owen used the name *Rhynchocephalus* ("beak head") which

is still in use as a name for the order of reptiles to which *Hatteria* belongs but no longer for the animal itself—a somewhat academic distinction since *Hatteria* or *Sphenodon* is the only living rhynchocephalian. As regards common names, the French have adopted the Maori word (with French pronunciation) while the Germans call it *Brückenechse,* the latter part of the name meaning "saurian" and the first part (bridge) referring to a feature of the skeleton.

The sluggish bearer of all these many names entered scientific literature in 1831 when Edward Gray published a short paper with the title "Note on a Peculiar Structure in the Head of an Agama." To call *Hatteria* an agama—a quite modern kind of lizard—was wrong, but the structure was peculiar enough. It was so peculiar that a naturalist by the name of Günther went after it with great thoroughness and in the course of time produced another paper with the title "Contribution to the Anatomy of *Hatteria*" in which he came out flatly with the statement that this "structure" which had interested Gray was a third eye! On the top of the reptile's head a ring of scales surrounds a larger and transparent central scale. Underneath that transparent scale there is an eye, small in size but well formed and, as far as can be told, able to function.

During the Triassic Period, when reptiles like *Sphenodon* made their first appearance, third eyes were quite stylish among reptiles, as we can see from their fossil skulls. Later they apparently did not find much use for it, at any rate it disappeared. A rudimentary third eye can still be found in the skulls of many living reptiles, in fact even Man himself has such a rudiment in the form of the pineal gland in his skull. But in almost all living reptiles the "pineal eye" is hard to find and the nerve leading to it has atrophied completely. In *Sphenodon* they are both well developed. Runner-up in that respect (and only runner-up) is the large black leguan *Amblyrhynchus* of the Galápagos Islands; the pineal eye and its nerve are not as well preserved as is the case with *Hatteria,* but almost so, and they are also still functioning.

As distinct from the kiwi, the paleontological history of this three-eyed living fossil is well known. In a later chapter (20, The Origin of the Mammal) we'll become acquainted with a group of ancient reptiles

which probably gave rise to the mammals. That was during the Permian Period, a little over two hundred million years ago. Soon after these had branched off, the reptiles began to split into a number of orders of which some are now completely extinct, while others are still vigorous. The earliest of these orders is that of the turtles, although no particularly ancient type of turtles is still alive. The second in order of age is that of the rhynchocephalians, now represented by *Sphenodon.* It might be interesting to tabulate the orders of the reptiles here, roughly in historical sequence of their origin. Of the youngest, the snakes, it may be remarked that they split off the lizards quite late, during the latter part of the Cretaceous Period. All others originated during the Triassic Period, while the rhynchocephalians and the turtles date back one more period, to the Permian.

Order of the Class of Reptiles	*Number of known species*	*Remarks*
Turtles	250	slow and steady increase since their origin
Rhynchocephalians	1	flourished during the Triassic, since then rare
Plesiosaurs	(75)	extinct
Ichthyosaurs	(75)	extinct
Dinosaurs	(5000?)	extinct
Lizards	2700	increased steadily since end of Cretaceous Period
Crocodiles	24	same as lizards
Pterosaurs	(60)	extinct
Snakes	2400	same as lizards

Figures in ( ) mean extinct species, others living species.

"Flourished during Triassic, since then rare" about describes the fate of the rhynchocephalians. Remains have been found in many Triassic deposits, also in southern Africa. During the following period, the Jurassic, they became less numerous, but spread themselves to the New World, Wyoming, to be specific. Among the Jurassic rhynchocephalians there is one, called *Homoeosaurus,* which has been found in Bavaria and in England and which, if it were still alive, an observer

could not tell from the modern *Hatteria,* except, possibly, if it happened to have a different coloration.

During this spread in Jurassic times they reached Malaya, New Guinea, and, across a then existing land bridge from New Guinea via New Caledonia to the North Cape of New Zealand, their present home. It was just a stroke of good luck for everybody concerned that the land bridge disappeared during the Cretaceous Period. Not even the marsupials got to New Zealand any more. Both kiwi and *Hatteria* were safe. There was no feud between them and the moas, a full thousand miles of ocean protected them against invasion, and the only arrivals in recent times, the Maoris, fortunately formed superstitious legends about them and left them alone.

Disaster almost struck some one hundred and fifty years ago when white settlers came (unaware even of *Hatteria's* existence) and introduced pigs. The pigs decimated the three-eyed living fossils as thoroughly as they had decimated the dodos on Mauritius. At the time of the arrival of these settlers *Hatteria* lived over both main islands of New Zealand and on a large number of rocky islets off the coast. Now there are none on the two main islands (of course we can't tell about, and may hope for, the more remote sections) but the rocky islets off the coast were left undisturbed. Of sheer necessity, one may add, because even now it is almost impossible to land on those islets, climbing them is another impossible job, and, in addition, it is forbidden.

The Dominion government has done what a government can do to protect this unique survivor from before the Age of Reptiles. In the entire dominion it is absolutely forbidden to kill a *Hatteria* or even to keep one as a pet. Furthermore, it is absolutely forbidden even to land on those islets where they have become numerous again because of that protection. Alone in the Bay of Plenty (North Island) there are five *Sphenodon* reservations: Karewa, Mercury, the "Poor Knights," the "Court of Aldermen," and the "Big Chicken" Islands. As can be guessed from the names, some of these reservations are groups of islands. Every once in a while the representatives of an acknowledged scientific institution are permitted to land and make some studies, but only twice during the last twenty-five years (to my knowledge) was permission granted to take a specimen.

Because of these observations we are well acquainted with their life habits.

The food of the *tuataras* consists of small animals of all types—beetles and grasshoppers, worms and spiders, occasionally a small lizard. They swim well and like the water, and it is possible that they sometimes catch small fish to vary their menu. They can dig holes in the ground, too, but it is interesting to note that they almost never make their own burrows. These are dug by the *tuatara's* regular roommate, the petrel bird.

If these petrels ever built nests in the open, they long ago gave up doing so in favor of what may be aptly termed underground air-raid shelters. The petrel's net is a tunnel measuring some five inches in diameter and about one yard long which leads to an underground chamber about two feet square and about six inches high. It is comfortably lined with dry grass and dead leaves. When the petrels started constructing these underground nests, the *tuataras* evidently decided that this was just what they wanted and moved in with them. The birds do not seem to mind. They have even elaborated upon the structure, so that it is now a firmly established rule that each of the tenants lives in a separate nest, the petrel to the left and the *Sphenodon* to the right of the entrance. Of course the lizards have most of the advantage; it is, in fact, hard to see how the petrels benefit at all from the association. Some zoologists have guessed that *Sphenodon* keeps the house clean by eating the remains of the dead fish brought home by the petrel for its own supper, but there is no certainty about that.

How well New Zealand was isolated from the rest of the world by the collapse of that land bridge in Cretaceous times is shown by a little inventory of its animal life, not counting insects. To begin at the top with the mammals: there are two bats!

That there are twenty-three varieties of dolphins, whales, and seals along the coast line is interesting, but has no bearing on the fact of isolation. There are over a hundred varieties of birds, some of them of exceptional beauty and all of them now provided with undisturbed bird preserves. But the point is that with the exception of the kiwi they are all good flyers.

There are fifteen species of reptiles, of which *Hatteria* is one. The

others are all lizards, mostly skinks and geckoes, types common to the South Pacific. They could all have arrived on driftwood—and probably did. Since snakes are a recent form of reptiles, one should expect them to be absent, which is correct. Because turtles are so old, one should expect turtles, but they are lacking too.

But there are three frogs—no toads, no salamanders, no newts. Of the three frogs, one is an Australian tree frog which arrived recently and does not count, since it was introduced on purpose. The other two are as ancient among frogs as *Hatteria* is ancient among reptiles; they are also closely related to each other. One, the New Zealand frog, *Liopelma hochstetteri,* lives only on the Coromandel Peninsula of the North Island. Aside from its archaic anatomical features it is interesting because it does not have a free larval stage. The eggs are deposited in the ground and the tadpole remains inside the egg capsule until all four legs have developed. It hatches as a complete frog.

The other frog, *Liopelma hamiltoni,* lives on Stephen Island. Nowhere else. Stephen Island is the same island where a cat discovered and destroyed the Stephen Island Wren. If you look at a map you'll easily find Cook Strait, which separates the South Island from the North Island. At the northern end of Cook Strait there is a small island which is still shown on most maps. Its name is d'Urville Island. And some four or five miles north of d'Urville Island a specialized chart will show Stephen Island. Photographs of it look as if it were merely a large heap of rocks, with some underbrush on top. And a lighthouse. The inhabitants are three lighthouse keepers, their families, and a female schoolteacher.

When a visiting biologist, decades ago, turned up a frog on Stephen Island, nobody believed him. But he could convince the doubters because he had specimens. It was established that it was a close relative of the Coromandel Peninsula frog. Anything specific about its life is not yet known. Nor does anybody have an idea why there should be a frog just on Stephen Island and not anywhere else. In 1935, when Professor Blanchard of Boston went to Stephen Island, it was still there.

And the other inhabitants of Stephen Island, not counting the lighthouse people, are *Hatterias* and their bird companions.

19: Two-Thumbed Teddybear

NEAR Sydney in Australia there is a small nature preserve called Koala Park. It consists essentially of a number of eucalyptus trees and the koalas inhabiting them. And the standard exclamation of all visitors—Australian friends tell me—whether American or European, is: "Don't they look *just* like teddybears!"

There can be no doubt about the resemblance, but the comparison works the other way round: the koalas do not look like teddybears, but the teddybears look like koalas. They not only look like koalas because koalas inhabited the earth, and more specifically Australia, for a minimum of a couple of million years before the first teddybear of commerce was made, but also because the teddybear was fashioned after a stuffed specimen of a koala.

The artist who fashioned the world's most universal toy and the man who was the first to discover the original share the same fate: their names are unknown.

Australian scientists, as may be imagined, have spent time and effort in generous measure to trace the story of the most humanly appealing animal of their continent. But so far they have failed to come up with the straight statement that Mr. So-and-so saw the first koala on this and that date in this or that place. All they have been able to find out is that a young man who remained anonymous set out from the then very new settlement at Port Jackson and traveled inland. That was in January 1798. After a journey of some sixty miles he reached the (Australian) Blue Mountains, and there he saw koalas sitting on the tall trees.

Port Jackson, near Sydney, was sighted and named by Captain Cook, but it was not utilized for some years to come. It began to exist as an

inhabited place in 1788 when it was founded as a penal colony for English criminals. This fact may or may not account for the fact that the discoverer of koala preferred to remain anonymous; at any event he must have had some measure of education because he stated that it "greatly resembled the sloths in America." He also reported that the natives called the animal *cullawine,* a rather poor rendering of the name.

Since koala, just like the South American sloths, does spend the major portion of his lifespan of about fifteen years in treetops, the comparison to the sloth was to some extent justified. And for a short while the name stuck. A now very rare book, published in 1810, calls it "Koala or New Holland sloth." But in 1814 the French zoologist H. M. de Blainville came up with a scientific name for the new discovery. He called the animal *Phascolarctos.*

This imposing-looking name is compounded from the two Greek words which mean "bear" and "pouch." Five years later the German zoologist Goldfuss added the second part of the scientific name by calling it *cinereus,* so that the full name, when translated, reads "ash-colored pouched bear."

The scientific name eliminated the label of "New Holland sloth" or "Australian sloth" in Europe. The Australian settlers had never used it themselves; they went by plain resemblance and called their strange arboreal marsupial the "native bear." A small boy of the present generation of Australians went them one better by calling the koala the "baby-faced bear." But the grown-up Australians now mostly use the native name of "koala," even though nobody is quite sure what it means. Some experts have advanced the explanation that this native word means "does not drink," and even if it does not mean that, it is at least true.

The koala literally never drinks. When he does, the zookeeper knows that he has a moribund koala on his hands. Every specimen that has been seen to drink water has also been found dead a few days later. Another thing the koala does not do is sweat. If hot it will lick its dense and woolly fur and presumably get some cooling effect from the evaporation of the moisture. Because it does not sweat, the koala always gives the impression of extreme cleanliness; it never produces any odor like the famous concentrated wet dog, but smells sweetly, if sometimes strongly, of eucalyptus oil.

Koala also has no lice or other external parasites, but it does suffer from ticks, and is not free of intestinal parasites. At least three different kinds of tapeworms have been identified. Since koala subsists exclusively on eucalyptus leaves—with some young bark thrown in—its intestinal apparatus is rather large and Nature apparently found that the normal intestinal tract could not handle the difficult job of extracting enough nourishment from leaves. For this reason koala is equipped with the biggest vermiform appendix of the animal kingdom, up to eight feet long, which constitutes a secondary digestive tract.

When looking at photographs of koala (only Australians can watch the real article in the open) the main impression is furnished by the comparatively large head and the big hairy ears, not to mention the large nose, which looks as if it were made of black rubber. Koala seems to wear a permanent expression of mild surprise, relieved only occasionally by something like hurt dignity or absent-minded concentration. But once you tear your eyes away from its comical face and the large head (the skull of a thirty-inch koala is five and a half inches long) the strange shape of its hands and feet will become apparent.

Koala's foot may be compared to a human hand, or, better still, to the hand of the big apes. The four toes are of fairly equal length (with the "ring finger" the longest) and bear sharp and long claws. The "big toe," like the thumb of the apes, is set far apart and does not even have a nail. The hand has five fingers of about equal length (again the "ring finger" is longest) and all have long sharp claws. But the hand is cleft not between the thumb and the other fingers, but between index finger and middle finger. Koala literally has two thumbs and holds on tightly to its tree branches with that arrangement. Koala is a slow and careful climber who prefers to sit down in a fork whenever possible. That a koala slips and falls out of a tree is a great rarity; on the ground the animal looks clumsier than it actually is. Though it does spend most of its life in the trees it sometimes has to migrate from one tree to another at ground level.

To human eyes a male koala looks very much like a female koala, or, as zoologists put it, "the secondary sex characteristics are inconspicuous," but the koalas themselves don't make mistakes. Each male has a small but jealously guarded harem. Young males which have reached

Koalas

(Drawing by Olga Ley)

adulthood are pushed out of the family, often literally. But sometimes the old male will lose. At any event the lonely male will sit down somewhere and start braying, at least that's what it sounds like to human ears. But to female koala ears it is a siren song which is absolutely irresistible and the male thereby collects a new small harem for himself.

As is the case in all pouched mammals or marsupials the koala is born as an unripe larva; it is hardly credible but a fact that the animal which may reach a weight of thirty pounds is smaller than a newly born mouse at birth. His mother stuffs him into the pouch, where he

remains for several months. Then the young koala is transferred to his mother's back, where he is carried about for a long time, almost a year. Even when the young koala is already able to climb around by himself he will still return to the mother's back, especially for feeding. Since koala, like *Homo sapiens,* is supplied with a clavicle or collar bone (incidentally, it lacks a patella or kneecap) the mother is able to reach behind her and pass branches to the young on her back. The same ability of moving the arms freely has the interesting result that mama koala can spank her young.

One young koala, kept in captivity with his mother, had the habit of climbing out to the very end of thin branches where the mother could not follow. The keepers could see that she was worried and wondered what she would do. At the very first opportunity mama koala grabbed her offspring—single, like all koala offspring—and spanked him on the part where koalas, bears, and people sit down. Young koala wailed and yelled so that cars passing by stopped and the drivers came out to see what was going on. But neither wailing nor audience influenced mama koala, she kept on thrashing the young until *she* found the punishment sufficient. It may be added that the young koala was intelligent enough to realize what had brought the punishment on his head, or elsewhere, and did not climb out on thin branches any more.

Because there is only one young at a time, and because the care of that young keeps the mother busy for so long, koala is slow to reproduce. A female can have a young only once every two years and usually not that often. Even with that slow reproduction the number of koalas which once inhabited most of eastern Australia must have been enormous. Koala's pelt is warm, durable, and rather beautiful, and for many years koala was hunted for its pelt. Otherwise it was of no commercial value; it is stated that the natives ate koala and liked the meat, but the few whites who tried it delivered highly contradictory reports. One of them said that it was good and reminded him of the meat of real bears which he had hunted in Russia, while others stated that it was abominable, smelled of eucalyptus oil, and would be eaten only by a starving man.

But there was no disagreement on the value of the pelt. Koala pelts were shipped from Australia by the hundred thousand in the past, and

as late as 1920–21, 205,679 koalas were killed. This is over now; as koala was getting rare, the law stepped in to protect him from extinction. No doubt the example of the American bison was cited in the proceedings, but just as American scientists worried about the survival of the bison even after the necessary laws were passed, the Australian scientists worried about the survival of their koala. They still do, even though the main mystery has been solved some years ago, mainly because one man, Ambrose Pratt, the president of the Royal Zoological Society of Victoria, exerted all his influence in that direction.

The mystery was this: koalas which were kept in zoological gardens invariably died. They died suddenly; it seemed as if the disease which attacked them progressed beyond help before the first symptoms began to show. The maximum life span of a koala in a zoological garden was recorded as four years, fifteen would have been normal. In one instance fourteen koalas died within a period of one year after admission to the zoo. Three others which had escaped earlier had been found to have made their home in an old nearby tree and had been left there under observation. They stayed in that tree for a full three years, then they were recaptured and put back into their enclosure. They died within nine months, apparently of indigestion.

Ambrose Pratt, who witnessed the tragedy, was desperate, but certain minor facts had already put the germ of an idea into his mind. Naturally every dead koala had been dissected to find the nature of the disease which had killed it. In all cases the result had been negative. And since the death had always been sudden, with hardly any warnings of disease, Pratt had thought of poison. Not deliberate poisoning, of course, but some natural poison. The regularly occurring deaths of captive koalas had naturally been taken to be a medical problem. What if it was a chemical problem instead?

Pratt had seen a clue in that three-year stay of the escaped koalas in a nearby old tree. While captive, these koalas had been fed select fresh branches of eucalyptus. Escaped, they retired to an old tree, happily chewing tough old leaves. Recaptured, they died. Of course even in freedom koalas did not always eat old leaves . . . but might not the whole performance be an indication that there was something chemically wrong with young leaves? At least temporarily or, perhaps, periodically?

It has to be explained first that koala does not feed on just any eucalyptus tree. The eucalyptus trees—Australians call them gum trees—are a large family of over two hundred varieties. More enthusiastic botanists even distinguish over five hundred varieties. Koala eats the leaves of about five and prefers one or two specific kinds which, however, are not the same anywhere. The favorite eucalyptus of the northern koala (remember that in Australia the northern sections are the warm sections) is not the same as that of the southern koala, which, incidentally, is much larger, although all koalas belong to the same zoological species.

In addition to having numerous varieties, each eucalyptus produces two kinds of leaves. When young, it has leaves for a short period of time which look very different from the normal leaves. These leaves are called "juvenile leaves" and they are not restricted solely to very young trees. If a tree is badly injured by accident, capping, or fire, the new shoots springing up will bear "juvenile leaves." Although not a botanist himself, Ambrose Pratt naturally knew these facts. What he did not know was that some plants, under certain circumstances, produce hydrocyanic or prussic acid. One of the botanists with whom he conferred, P. R. H. St. John, knew definitely that one kind of eucalyptus could produce prussic acid. And he remembered having read somewhere that one of the favorite food trees of the koala did too. The search was on. Once the searchers knew what to look for, they found numerous references stating that this or that of the many varieties of eucalyptus had been found to produce prussic acid. This was the case especially when the leaves had been macerated or frozen.

But all this seemed to apply mostly to the so-called "sugar gum" tree, not to the "manna gum" (*Eucalyptus viminalis*), koala's favorite. Just at that point three chemists who were totally unaware of the uproar in the zoological section published a paper on the prussic acid-producing compounds in Australian plants. They stated calmly that the "manna gum" could produce the poison too. And, more important, they stated that the amount of these compounds was largest in juvenile leaves and also generally in young leaves of young trees! Those of the sugar gum contained enough prussic acid to kill a sheep in less than one ounce of leaves!

This, of course, taught a big lesson to the zoologists. No juvenile leaves

for koala feeding. No young leaves from young trees, either, without providing a choice of old leaves simultaneously. Koala, if given a choice, never errs in avoiding toxic leaves even though they look fresh and harmless to its keeper. The large nose of koala may be the warning instrument; but even in freedom, after a bush fire, koala is sometimes forced by hunger to disregard the warnings. Then "mysterious" mass deaths of koalas take place.

Unfortunately the discovery of prussic acid in eucalyptus leaves did not solve the whole problem. There seemed to be a second plant poison around which koala sometimes tolerated and sometimes not. Or which varied in strength with the season. Or koala's tolerance varied with the seasons. Or something more complicated than that. Suspicion centers around a substance called cineol. Chemists know its formula—it is $C_{10}H_{18}O$—and know that it lowers the body temperature. And there is another substance, called phellandrine, of the formula $C_{10}H_{16}$, which is not as clear-cut in its physiological action but seems to raise the body temperature. Both these substances are contained in the essential oil of the eucalyptus leaves. The amount varies, both with the variety of tree and probably also with the climate in which it grows.

Ambrose Pratt feels inclined to blame a large number of koala deaths in the (cooler) southern parts of Australia on cineol poisoning. And he thinks that the northern koalas prefer trees with more cineol to keep them cool, while the southern koalas prefer trees with more phellandrine to keep them warm. Again, the koalas can tell; the mistakes were all made by the keepers and a koala which was sufficiently hungry would, of course, take leaves which he would not touch otherwise.

The survival of the koala in zoological gardens therefore turned out to be a problem of providing a choice of food trees, preferably old trees. Once that was known, the remedy was comparatively simple: no tight little enclosures, but large open enclosures with old trees growing in them naturally.

As regards the survival of the koala in nature, literature is full of contradictory reports. Many Australian scientists seem to belong to the school of viewing with alarm. But C. A. M. Reid, who was in charge of the Australian fauna put on display at the Golden Gate International Exposition at San Francisco in 1939 (koala was excluded from that),

stated that "the koala may be dying in New South Wales, but in Queensland, which is its hope, there are easily eight hundred thousand of them in the bush, and each year they are coming back to areas they had deserted."

Koala had been excluded from that exposition because it had been thought that it would be impossible to provide eucalyptus leaves. But when in California Mr. Reid discovered to his surprise that six different varieties were available within easy reach of the exposition. This means very simply that koala could be introduced in California. And that seems like an appealing idea; it would be nice to give the two-thumbed teddybear as large a range as possible.

20: *The Origin of the Mammal*

IN POPULAR belief a paleontologist is credited with unusual powers. Most people, when asked (assuming that they know anything about the subject at all), will express the conviction that a paleontologist needs only one bone of an extinct animal to tell what it was like, how big it was, whether it was a violent carnivore or a peaceful grass-eater, how many young it had as a rule, and so on.

Actually this is like expecting a meteorologist to tell the weather of the following day after one glance at the sky. In short: it can't be done.

But since there are exceptions to every rule there is an exception to this statement too. In some cases, when weather conditions are nice and stable as happens in midwinter or midsummer, a meteorologist may be able to predict the next day's weather with just one glance at the weather map. And in one particular case the paleontologist needs nothing but one bone to make a number of statements about an extinct animal. That particular case comes true if the bone is a lower jawbone, complete and with teeth.

It would be hard to find anybody who has not seen a lower jawbone of a mammal, be it dog or cat, horse or cattle, or, for that matter, human. It is easy to describe, too, just a bone with teeth in it. The rear end is often somewhat curved upward to hinge on to the skull. And, of course, there is a left and a right jawbone, but since they do not differ otherwise we can be satisfied in looking at just one side. And the teeth in it are not at all alike. Not only do the teeth in a human jawbone differ from the teeth in a dog's jawbone; in each jaw there are different kinds of teeth.

That picture, to an anatomist or paleontologist, spells "mammal" without even requiring a second glance.

But now consider the jawbone of a reptile.

It looks as if it had been made up of odds and ends. In front there is the bone which has the teeth in it, for obvious reasons it is called the *dentary*. But in a reptile that dentary is not elongated in the back and somehow hinged to the skull. To begin with it is re-enforced at the bottom by a longish piece called the *splenial*—not even all reptiles have that. But they all have the bone which is named the *surangular,* which is attached to the end of the dentary. And the surangular is braced at the bottom by the *angular*. At their rear end they carry another one called the *articular,* which is the lower half of the hinge. To finish up with complications what began with complications, this whole bridgework of girders and stiffeners is not hinged to the skull directly, but attached to another girder reaching down from above: the square bone or *quadrate*.

Again, it needs only one glance at all this to spell "reptile."

And this is the reason why paleontologists, when they carve a lower jawbone out of the rock, are never in doubt whether they are dealing with a mammal or a reptile.

But several decades ago a number of jawbones came to light in South Africa which threatened to upset the scheme. The formation in which they were found is called the Karroo and it is quite old. Not just old as one uses the word in talking about, say, the ancestors of the horse, but old in the sense in which we spoke about the ancestors of *Sphenodon*. They stemmed from the Permian Period, that period which succeeded the period of the endless carboniferous forests and which brought a first glaciation, with all the earmarks of the later glaciation which was called the Ice Age. In fact, it seems to have been more severe.

Of all the reptiles of the Karroo, one can say that they were strange. To us, who are usually thinking of nervous lizards and fast snakes when the word reptile is mentioned, they did not look like reptiles at all. They were short and squat, like large armored toads with a short tail, sometimes like a reptilian edition of a big English bulldog with a stubby but very heavy tail—short tails in themselves are very

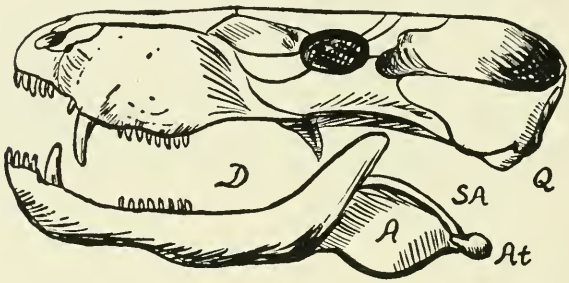
strange in reptiles. And they all look as if they were not more active than the large land tortoises of today; in fact, the ancestors of the whole tribe of tortoises and turtles seem to have originated at that time.

As for their jaws—yes, they did follow the reptilian scheme of a dentary which does not comprise the whole jawbone, but which has surangular and angular and so on, with a quadrate reaching down from above. But the dentary was by far the largest of these bones, it seemed as if a process of shedding of superfluous structure had been going on. In a few cases the lower jaw was hinged to the quadrate by an upjutting corner of the dentary, the whole rest of the complicated structure trailing behind in obvious uselessness. As if to make the similarity to a mammal's skull even more pronounced, the teeth too began to differentiate. When you look into the mouth of a crocodile—often obligingly kept open for just such studies—you can see long rows of teeth. But while they differ somewhat in size in different places in the mouth, they are all alike in shape and also in construction. Those Karroo reptiles [1] not only began to have teeth which differed somewhat in size, they began to have different kinds of teeth—a thoroughly unorthodox style for a reptile.

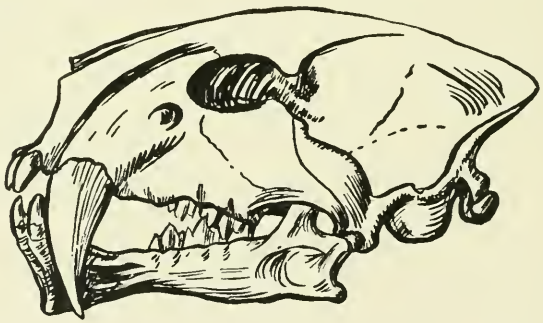
The similarities were so obvious that they were seized upon in naming groups of these reptiles. One was called *Theriodonta* ("those with mammal teeth"), another *Theriocephalia* ("those with mammal heads"), and one even *Theriomorpha* ("those of mammal shape"). Since the mammals as a whole had to have sprung either from reptiles or from amphibians and most probably from reptiles which still had some amphibian characteristics (e.g., nonscaly skin with skin glands) suspicion was rife that the origin of the mammal was to be found somewhere in that neighborhood. This suspicion was strengthened by the fact of that old glaciation. Obviously the reptiles had not been able to do too well in such low temperatures and had begun to acquire a mechanism for keeping their blood temperature at roughly the same level, even though it was expensive. Almost eighty per cent

[1] While I am speaking of forms from the Karroo, it should be pointed out that related forms have been found, if rarely, elsewhere too, for example, near Elgin in Scotland, near the Dvina River in Russia, in the Russian district of Wologda, and in Texas.

Skull of *Stenopterygius acutirostris* (ichthyosaur) from the Jurassic (*Lias epsilon*) of Holzmaden, Southwest Germany



Skull of the therocephalian ("mammal head") *Scylacosaurus sclateri*, from the Permian of the Karroo formation in South Africa. Teeth are beginning to show nonreptilian differentiation, and dentary has grown to be the largest bone of the jaw



Skull of *Machairodus cultridens*, a "sabertooth," from the Lower Pliocene of Greece. Lower jaw consists of dentary only, teeth are differentiated

D	dentary	Sp	splenial	A	angular
Q	quadrate	At	articular	SA	surangular

Three fossil skulls showing typical differences in dentition and construction of jawbone (Drawing by Olga Ley)

of the food intake of a mammal is used up to keep the body warm, only the remainder is expended on activity, growth, and reproduction.

If there is a way by which one can tell from fossil bones whether their possessor was warm-blooded or not (not counting the obvious of mammal or bird bones) we don't know it yet. Consequently we can't say whether the "mammal heads," "mammal teeth," etc., etc., tried to be warm-blooded and how well they succeeded. Nor do we know anything about a possible skin covering that kept the heat in, or about possible skin glands which helped to cool the mechanism if necessary. All we do know is that we are suspicious of reptiles with a changing dentition and a jaw development in the direction of mammalian pattern. We also know that we are especially suspicious about a group called *Cotylosaurians.*

And we do know that *Tritylodon,* which lived during the Triassic Period, i.e., in the period following the Permian, was indubitably a mammal. But that Triassic Period was in itself just the first of the three periods which saw the exceptional and somewhat incredible expansion of the reptilians. For more than one hundred and thirty million years the true reptiles, and not their offspring, dominated the scene. They swam in the high seas, they populated the shores, they walked the dry land, they burrowed underground, and they even learned to fly through the air. The mammals, both smothered by numbers and outranked in individual size, had to stay in hiding.

It has been mentioned repeatedly in foregoing chapters that there are three kinds of mammals: the monotremes, the marsupials, and the placentals. At present this is the sequence of their abundance on earth, with the rarest first. But it is also the geological sequence of appearance. A point which has been mentioned more by implication than directly is that each one of the three types is capable of producing all the functional forms which are so familiar to us today.

There are now in Australia marsupial carnivores like the so-called "native cat" (*Dasyurus*) and, in Tasmania, the "Tasmanian Devil" (*Thylacinus*). There are herbivorous marsupials like the kangaroos. There are extremely arboreal types like our friend the two-thumbed teddybear koala, and there are marsupial moles (*Noctoryctes*). There

are even marsupial counterparts to our flying squirrel. In the recent past Australia saw marsupial counterparts of the rhinoceros and elephant, and the recent past of South America even saw *Thylacosmilus*, a believe-it-or-not animal, namely, a marsupial sabertooth.

No doubt the monotremes also branched out into quite a number of specializations. There probably were monotreme carnivores, monotreme burrowers, monotreme tree-climbers. We know very little of them because mammalian fossils from the periods of the big reptiles are rare, probably because their normal "burial" was in somebody else's stomach. Besides, they could not expand as much as they would have done if they had had the earth to themselves. To begin with, the reptiles were around, and they were going vigorously into all these specializations too. And after a while the second mammalian group, the marsupials, made its appearance.

It probably happened during the Jurassic Period. One of the early mammalian fossils of which we are sure that it is a marsupial came to light in 1915 in Alberta, Canada, when Dr. Barnum Brown of the American Museum of Natural History excavated the skeleton of a horned dinosaur. Both the dinosaur and the marsupial were evidently of the same age, they might even have died together. Needless to say, the few tiny bones (the jawbone among them) of the marsupial were of much higher scientific interest than those of the dinosaur. You expect dinosaurs in Cretaceous deposits, but mammals are a rare find. The late Dr. W. D. Matthew examined them and called the small mammal *Eodelphis,* or "dawn opossum." It was not only a marsupial but definitely an opossum, smaller than the present-day variety, but not different from it in any important respect.

Eodelphis must be called comparatively late among the marsupials of the reptile age. We know they must have originated earlier than the Cretaceous Period, because Australia is full of them. And we know for many reasons that Australia became an independent continent during the preceding period, the Jurassic. It still had some monotremes, which must have had a world-wide distribution, and it still got marsupials. But it got only a very few and quite small placentals. Hence Australia's "secession" from the bigger land masses to which it had

been attached provides a clue to the probable time of the origin of the placentals.

Just as the marsupials must have sprung from the monotremes some time, some place, the placentals must have sprung from the marsupials. The essential requirement was, of course, a modification of the body mechanism governing the prenatal history of the young. This modification is not hard to visualize in general outline. Marsupials do not lay eggs any more as do the monotremes, consequently an internal connection between mother and young does exist. In a "pure" case it might be mechanical only, nutrition being furnished by the yolk sac. But one might imagine that the yolk sac, in turn, were replenished by the mother, something that does exist even in non-mammalian animals. Some sharks provide a surprising example of something of the sort.

Then, if by way of greatly improved and prolonged internal nutrition the young should emerge in a more ripened condition, there would be no need for a pouch any more.

Beginnings of such changes can be observed all along the line. A small number of marsupials belies the name by failing to have a pouch, the banded anteater of Australia (*Myrmecobius*) which looks like a big but very friendly rat is the best known example. Its young cling to the teats openly, concealed merely by the long belly hair of the female.[1] And while there are some marsupials without pouches, there are also some which produce such an internal nutrient-conveying connection between mother and child, called "false placenta."

Forms with a well-functioning placenta *and* a pouch do not exist —or maybe it would be safer to say that there are none at present. There may have been some like this, although one can also imagine that the step from the marsupial to the placental was made without them. The lowest rung on the ladder beyond the marsupial would be

[1] Some authors have suggested that this is to be taken as a very primitive feature, implying a high geological age of these types. But this idea is untenable, just because the few cases of pouchless marsupials are scattered around in various families not closely related to one another. If they were taken to be primitive, one would have to accept the theory that all the others that do have pouches acquired them independently. It is easier by far to imagine the independent loss than an independent acquisition, especially since there are so few without pouches.

a mammal with placenta and without pouch, but otherwise not greatly specialized in any one direction. That would be the mammal, or the group of mammals, from which the higher placentals evolved: our whole zoological garden of today, including keepers.

Geologically such primitive "super marsupials" are established in the very early parts of the Tertiary Period and, paleontological luck willing, might be dug from late Cretaceous layers.

Zoologically they are still with us, all around and sometimes literally underfoot; only New Zealand and Australia are without them. They are the insectivores or insect-eaters, a term which, like most of such terms, applies to the majority of the members of the group, but not to all of them. They are actually omnivorous, with a very pronounced preference for live food. That the latter consists mostly of insects, their larvae, and worms, is caused essentially by the small size of the animals themselves. And they all have fabulous appetites.

These insectivores have managed a strange thing. Besides having given rise to all the higher placentals they have managed to survive in forms which look as if most of them were little-changed originals. And in addition to that they have succeeded in producing a number of specializations which compete with the same specializations of the higher placentals (or would compete if they lived in the same geographical localities) without losing their identity as insectivores. One might almost say that they tried to populate the world twice, once with adaptations of their own tribes, and once by producing the higher groups.

The term "insectivores" may not mean much to many laymen, but everybody knows some of their representatives. The moles which ruin the lawn are insectivores. In this country and in Europe they are as black as the darkness of their subterranean tunnels, but the South African Boer country has its fabulous golden moles—strangely enough, those marsupial moles of Australia have golden pelts too.

The shrews which flit like mice across clearings and ruin the temper and digestion of the cat that catches and eats one by mistake are insectivores too. So is one of the most amusing and friendly inhabitants of the Old World, the European hedgehog.

Some ten inches long and armed with a bristly thicket of inch-long

spines, he gives the general impression and has some of the habits of a small pig. He is forever restless and forever hungry, and cares little what it is he can catch. It may be fat grubs, or an earthworm or a beetle or a field mouse; to the hedgehog they are all edible. His very favorite food, however, is snakes: the hedgehog will attack and engage a snake four times his own length without the least hesitation. His method of disposing even of venomous snakes is so efficient that

European hedgehog (*Erinaceus europaeus*)
(Drawing by Olga Ley)

the peasants of Europe and of Russia are convinced that snake venom won't harm him. Actually that is not so, a hedgehog which is bitten in an exposed part gets sick and may even die like any other animal his size. But because of that armor of one-inch spines the snake cannot strike well, in fact a strike usually hurts the snake more than it hurts the hedgehog. He merely gets his thick pelt sprinkled with snake venom; the snake gets a few bleeding punctures in the sensitive tissues of the mouth.

When attacked by a superior enemy, like a fox or a dog, the hedgehog makes use of a special set of muscles which enables him to curl himself into a perfect ball, with head and all four feet tucked under.

Unfortunately, both foxes and dogs have learned how to cope with this defense: they roll the ball along until they come to a place where they can drop him into water.

The hedgehog uses his spines not only for defense but actually as tools. When autumn begins to give way to winter, he builds himself a hibernating burrow which is lined with leaves, and he picks up the leaves by rolling over on the ground until a load is stuck to his

African jumping shrew (one of the *Macroscelidae*)
(Drawing by Olga Ley)

back. Ripe pears are transported the same way—it has always been doubted that this is actually true, but several competent and well-reputed observers swear to have seen it.

If the hedgehog is an amusing little pig, the shrew is a vicious carnivore *en miniature*. The minimum amount of food on which a shrew will stay alive at all is its own body weight every twenty-four hours. The naturalist Lenz, who kept a number of specimens of the European forest shrew (*Sorex vulgaris*) in captivity, reported that he could not provide enough mealworms and earthworms to keep them satisfied. Every shrew ate daily an ordinary mouse, leaving nothing but

the bones and part of the fur—the house mouse is larger than the shrew, and the shrew ate a few earthworms in addition to the mouse. And while no shrew hesitated for a moment to eat a dead shrew, it would not touch anything vegetable at all, but would rather die of hunger.

The water shrew (*Sorex fodiens*) is, if possible, worse than its forest-loving cousin. It is about four inches long, of which precisely half is tail; but a water shrew will eat three large frogs a day. It will attack six-pound carps and eat their eyes and brain, occasionally portions of the fish's body.

As for the moles, they surpass even the shrews. A naturalist (Flourens) who wanted to find out what the common European mole considers its favorite food found to his horror that one of his moles ate two sparrows and a frog within thirty-six hours and was very hungry at the end of that period. Flourens then provided a live toad, but the obviously very hungry mole touched the toad just once with its sensitive nose. Twelve hours later the mole had died of starvation, although carrots, cabbage, and lettuce (and the toad) were available. Of ten moles which were put into a bare room, only two were still alive and present on the third day. The question of the favorite food was never settled—anything animal was favorite food, with the single exception of toads. Snakes were eaten with avidity. And nothing vegetable was ever so much as touched.

The shrews, moles, and hedgehogs do not exhaust the list of living "dawn mammals" by any means, they are merely the best-known representatives of this hidden tribe which, although ever present, is rarely seen. The comparatively large elephant shrews of Africa (*Macroscelides*—the name means something like "long leg") are to be excepted from that statement, since they love sunshine to such an extent that they don't even mind an observer, as long as he keeps still. They are about ten inches long—half of that, tail—and begin to approach the kangaroos and kangaroo rats in appearance.

More or less remote corners of the earth have preserved a number of unusual offshoots, branchings from the original insectivores, some with minor but unusual specializations. There is a rather large one on Cuba, *Solenodon,* looking like an attempt of the insectivores to produce a weasel. Then there is the *tenrek* or *tanrek* of Madagascar,

which shows a strong outward resemblance to the European hedgehog but belongs to another family. It is famous in zoological circles for two reasons. One is its (even among insectivores) unusual rate of reproduction: a litter of twenty to twenty-two young is the rule. The other is that in relation to its size it has the biggest mouth of any animal alive. Some zoologists believe that this large mouth is an adaptation which has something to do with the fact that Madagascar produces earthworms three feet long and more than an inch thick. Whether or not the earthworms of Madagascar have anything to do with the size of the *tanrek's* mouth, it is generally conceded that *tanrek* has the biggest mouth of any mammal.

Another insectivore from Madagascar, *Geogale,* has slipped into books and articles mostly because of the fact that it is the only close living relative of the African *Potamogale,* the largest of the living insectivores, actually addicted to a straight fish diet and a kind of "insectivore" otter. *Potamogale* really belongs in the next chapter, and has been mentioned at this point only to show where the order of the insectivores begins to dissolve. If somebody tried hard enough he could make out a case for removing *Potamogale* from the insectivores and putting it, along with *Geogale,* into an order of its own.

Just this has happened to a most strange mammal of southeastern Asia. It is the mammal *Galeopithecus.* This word, compounded from two Greek root words meaning "weasel" and "monkey," makes no sense whatever and is easily the most ill-fitting zoological name ever devised. The trouble is that a better name is not possible, the English version "flying lemur" is just as bad, because *Galeopithecus* is not a lemur and it cannot really fly. In appearance it is a very large flying squirrel, but, of course, it is not a rodent. Its ancestors must have been insectivores, but as regards *Galeopithecus* we are not even sure of its diet. Its nocturnal habits make observation difficult, but the odds are that it is herbivorous (by now we realize how strange this is for a direct and little removed offspring of the insectivores) and one observer has guessed that it might eat the algae off bark and some bark along with the algae.

In older books you can still find the "family" of the *Tupaidae* listed

among the insectivores. The English name given to them is usually "squirrel shrews," which at least gives a good idea of their appearance and arboreal habits. The "Latin" name is actually not Latin at all, but is derived from the Malay word *tupaya,* which simply means "squirrel." But the "squirrel" which is so common on the Malay Peninsula and the East Indian islands, and which also occurs as far east as the Philippines and as far north as Burma, is not a rodent like our common squirrel, but—well, let's say for the present that it is a shrew-like animal. In the center of its native habitat it has a companion which also lives on trees and which originally was even thought to be an arboreal rat. The first specimen known to science was caught in the Rajah's palace at Sarawak, Borneo; it was sent to the British Museum and described for the first time in 1848. The six-inch animal has an eight-inch tail and that tail has a curious feature: two rows of long white hairs form a stiff fringe around its lower third. The describing scientist seized upon that feature for a name: he named it *Ptilocercus,* "feathertail."

These two were quietly listed as "squirrel shrews" for many decades, but some fifteen years ago somebody began a re-examination of their case. And that re-examination had a surprising result. As Dr. Erich M. Schlaikjer, writing in *Natural History Magazine* for March 1938, expressed it:

> . . . They have been promoted—promoted from the rank of Insectivore to that of a Primate! For up to very recently the specialists, while recognizing the many Primate-like characters, never seemed to be able to quite make up their minds whether they were orthodox Insectivores or belonged to our own order. Finally, however, the bars have been let down and these two squirrelish jungle dwellers are now rated as belonging to the order of Primates in good standing.

The Primates, of course, constitute the Linnaean classification to which we ourselves belong. It comprises, reading from the bottom up, the lemurs, the monkeys, the anthropoid apes, and Man. Now *tupaya* and feathertail have been placed below the lemurs, as being hardly changed survivors of the first Primatelike insectivores. That the Primates came from the insectivores in a straight line was known for a

long time, just as it was known for others, the horse, for example. But it took a long time, and required a lot of work and knowledge, to recognize the ancestral group in these two survivors from those fabulous islands where *Pithecanthropus* walked the slopes of the towering volcanoes.

21: *African Rhapsody*

IN THE African Southwest, some twenty miles inland from the coast, there is a strip of "badlands" which is locally known as the "Namib." Politically most of it belongs to the Portuguese colony of Angola, geographically it reaches from about Mossamedes in the north to Walfish Bay in the south. In that Namib there lives a relic of bygone days which is one of the proofs for the assertion that the continent of Africa is the most stable land mass on our planet.

This relic is not an animal but a plant. A German traveler, Friedrich Welwitsch, exploring for the King of Portugal, discovered it in 1860 and called it *Tumboa Bainesii.* But later it was decided to change the name and to honor its discoverer by naming it *Welwitschia mirabilis.*

The second part of that name is well justified by the facts, for *Welwitschia* is a tree. Fully grown it is about eighteen inches tall. But it is not a natural counterpart of those Japanese dwarf trees of perverted horticulture: *Welwitschia* is merely short—not small. That tree trunk which does not even rise two feet above the ground has a diameter of about four feet, thirteen to fourteen feet in circumference. As soon as the seedling stage is over, the tree sprouts two leaves; they grow directly from the trunk without any branches or twigs and they are all the leaves that the plant will ever grow during its whole century-long life span. These two leaves will reach a length of twelve feet or more and they are so tough and leathery that even hungry animals leave them alone after some tentative nibbling.

Theoretically the leaves are four feet wide when the plant is fully

grown, but nobody has ever seen an undamaged *Welwitschia* leaf. In fact, an undamaged *Welwitschia* leaf is merely an abstraction—like the square root of minus one, it has no existence in reality. Since the leaf has only parallel veins without cross connections it frays at the tip and is easily ripped lengthwise by a strong wind. The wind is not even necessary, because the leaf is split at the base by uneven growth of the trunk so that a large number of ribbons will form, of about equal length but of arbitrary width.

This strange plant is anchored in the ground by a massive taproot about five feet long, the whole looks like a colossal wooden carrot. But it is a fable that the taproot reaches down to the ground water; to do that in the Namib it would have to be thirty or forty feet long. As regards its water requirements, the plant subsists on the seasonal rains and on the fogs drifting in from the sea; because those fogs do not condense until they are about a score of miles inland, the plant does not occur closer to the coast. The fogs also carry a considerable amount of salt, and *Welwitschia* depends on it since as far as one can tell it will not be able to grow in unsalted soil. Its inland boundary presumably coincides with the range of the salty fogs.

Among plants *Welwitschia* occupies about the same place as *Hatteria* does among the reptiles, in fact it does go back to the same geological period. The ancestors of *Hatteria* and those ancient reptiles with mammal-like teeth and mammal-like heads lived among the direct ancestors of that lone survivor of the Namib desert.

Needless to say that the earth in those days had not only a different fauna and flora, but a different geography too. We have read in earlier chapters that New Zealand became isolated before the marsupials could get there. And that Australia, in turn, became isolated before the placentals could get there in numbers and decimate its ancient marsupial population. These facts permit a reasonably precise dating of the separations. Similar facts are supplied by the ages of geological deposits and their nature, although the main clues are always fossils. For example: coal deposits from the Carboniferous Period mean that there was land where those forests grew, forests of any kind mean land. Clams and oysters will indicate shallow water, corals shallow *warm* water, and so on. When, about half a century ago, geologists

had enough facts of this kind at their disposal, they embarked on the fascinating undertaking of drawing ancient maps. After a few preliminary attempts by Melchior Neumayr and a few others, the new science of paleogeography erupted with fair suddenness just before the First World War in two heavy volumes: the *Lethaea palaeozoica* by Friedrich Frech and the *Entwicklung der Kontinente* by Theodor Arldt.

Professors Frech and Arldt were both convinced that the map of the earth had been rather uniform, if greatly different from today, for a long period of time. They believed in the existence of three main land masses, one being North America and Greenland, the second the main mass of Asia, and the third a southern continent to which the name of Gondwanaland [1] was given. Gondwanaland began at about the West Coast of South America, comprised present-day South America, the Southern Atlantic, Africa, Madagascar, the Indian Ocean, all of Australia, and sometimes New Zealand. The sea which separated Gondwanaland from the two northern continents, covering Central America (and most of the time Mexico too), the Mediterranean and the northernmost portions of Africa and most of the time most of India, was called the Tethys Sea.

With minor fluctuations which concerned mostly the two northern continents, this general map picture held from the earliest days of the Cambrian Period until the beginning of the Jurassic. Then the pattern changed suddenly. North America and Greenland were still a solid block, but Europe became an archipelago of large islands. Asia acquired a number of deep indentations but made contact with Australia and, separately, with New Zealand in the south. The Indian Ocean had appeared and Gondwanaland as a whole was destroyed, but Madagascar, Africa, and South America still formed one continent. In the following period, the Cretaceous, the destruction of the ancient map was complete and the "new map" had almost emerged: South America, Africa, Australia, and New Zealand were all independent, but Asia was connected with North America across the Bering Sea, and

[1] "Gondwana" would have been sufficient. The first syllable refers to the East Indian tribe of the Gonds in whose territory Gondwana deposits were first recognized, while *wana* is in the Sanskrit word for "land" or "country."

North America was also connected with Europe across the "Iceland Bridge."

Naturally much of this was admittedly hypothesis even at the time when it was published, and some detail has been severely criticized since then. The main doubt is concerned with that connection between Africa and South America. The fact that these two were connected for a long time cannot be disputed, the question is mainly *how* they were connected. Many modern geologists feel inclined to doubt that solid land spanned the South Atlantic and would much rather believe that Africa and South America were connected by touching directly so that the South Atlantic was formed not by the breakdown of a piece of a continent, but by the separation of these two continents.

Fascinating as all this is, it interests us here mainly from the point of view that everybody is in agreement about the age and the stability of the African continent. It can, therefore, be expected to yield other survivors from past ages than *Welwitschia*. Since its periods of isolation were comparatively short it cannot be expected to present such a uniform picture of an ancient fauna as Australia. But it does have a number of highly interesting forms, of which the hyrax or coney is the most inconspicuous-looking. In fact it looks like a foot-long, fat, and pleasantly fuzzy rodent. The external tail is almost nonexistent, all four feet are small and slender, and on its large face it wears an expression of mild disgust and shocked surprise.

The variety living in Syria and in Palestine is mentioned in the Bible under the name of *Saphan,* but nobody in Europe knew what the word meant or had ever seen the animal itself. Since the context pointed to something small and furry Dr. Martin Luther finally translated *Saphan* as "rabbit." And one early scientific traveler, the surgeon Peter Simon Pallas (1741–1811) actually thought them to be rodents and hence reasonably close relatives of the rabbit. That was a mistake, caused by the fact that the hyrax's dentition looks superficially like that of a rodent (the teeth, taken singly, do not) but it took a long time until naturalists knew where to place it. They are not too sure even now, because it still depends to some extent on the point of view.

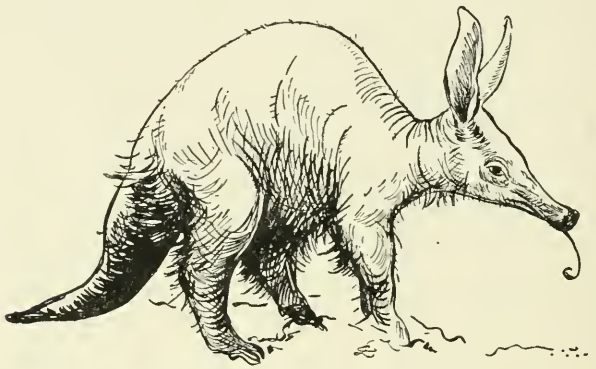
Cuvier, going by the structure of the cheek teeth, called him *une sorte de rhinocéros en miniature,* and others agreed to the extent that

they accepted hyrax as belonging to the ungulates or hoofed mammals. The reason was that the structure of its feet are like those of the odd-toed ungulates and that its stomach resembles that of a horse. In itself it was not too strange that there should be a small form of odd-toed hoofed mammals, but the story of hyrax, which occurs all the way from Palestine to the Boer country in the south and which also has developed a tree-climbing form in Liberia, took an unexpected turn when paleontologists began to dig in the Faiyum of Egypt.

The fossil beds of the Faiyum belong to the Middle and Late Eocene and that is rather annoying, since it is like coming in to the theater near the end of the second act. We would much rather have a few large fossil beds in that area from the preceding subperiod, the Paleocene. Things must have been moving then, and moving rapidly, judging by what that later stage presents. There is, to begin with, a tapir-sized mammal that has, after famous Lake Moeris, been called *Moeritherium*. It foreshadows in many features the coming mastodons and elephants, without being a direct ancestor itself. It is decidedly a sideline, and so is a hyrax the size of a small bear. What makes it really startling is that among all those early hoofed mammals there are also the first sea cows—it is no exaggeration to say that Steller's sea cow was actually more closely related to hyrax than the rabbit with which it was thrown into one pot later. And the same goes for the elephants. Hyrax, in short, is a leftover from the primitive group of original "sub-ungulates" which produced the divergent strains just mentioned.

This original group, be it noted, was already one step above the insectivores of which Africa still has its good share. Largest and most remarkable of them is *Potamogale velox,* which is, in fact, the largest living insectivore, with a body length of over twelve inches and a very strong, muscular, flattened tail fourteen to sixteen inches long. As regards diet it is an insectivore no longer, a fact which the zoologist who gave it its name wanted to express by calling it *Potamogale*. It means "river weasel," but the name "otter shrew" (proposed by Richard Lydekker) or "giant water shrew" (proposed by Ivan T. Sanderson) is probably better. Its diet consists of fresh-water fish, and for a long time it was believed that fresh-water fish are the one item to

the exclusion of all others. But Cuthbert Christy, a British naturalist, reported in his book *Big Game and Pygmies,* that he came across remains of fresh-water shrimp on a flat stone on which he had just seen a *Potamogale.* Since it probably has the same voracious appetite as the better-known insectivores of Europe and America, it is quite likely that it will accept anything aquatic and alive if there are no fish available.



Aardvark (*Orycteropus capensis*)

(Drawing by Olga Ley)

Potamogale itself is not known in fossil form, so we cannot say just how old it is. But we know an extinct relative from the very late Cretaceous Period, called *Palaeoryctes,* one of the earliest insectivores known to science. Its cheek teeth are exact duplicates of *Potamogale's* cheek teeth (or the other way round) except that those of *Potamogale* are four times as large. And the front teeth differ, those of *Potamogale* have developed into sharp little spears which will hold a wriggling fish.

Now we know at least about *Potamogale* that it is an insectivore. And we know of hyrax that it is an old and primitive ungulate. But when it comes to *Orycteropus* we are completely in a blind alley with any attempt of classification, probably as much as *Orycteropus* itself is in a blind alley in the evolutionary sense. The Greek name which I have just used means simply and plainly "the digger." The popular

name, due to an accident of Dutch spelling, happens to be the first word in every index. It is aardvark. Aardvark (plural: aardvarken) means "earth pig" or rather "earth shoat," and has been given to it by the Boers for the culinary reason that its haunches, when smoked, will yield a substitute for ham.

In appearance it compares to nothing else under the sun. Its body is short and heavy, its tail so massive that it should belong to a reptile. The ultra-powerful legs are armed with claws of such a size that the nomadic tribes of north-eastern Africa call it *Abu-Delaf,* "Father of nails." The elongated head with the very long muzzle is topped by two donkey ears which can move independently. It has scent glands which attract flies in countless numbers, so much so that spiders spin their webs across the aardvark's burrows and one can tell by the state of these webs whether the aardvark has been in or out of its burrow recently. The whole weighs one hundred and forty pounds when fully grown, is six feet long (the tail accounts for a little less than half of that), can dig so fast that it escapes underground from strong men armed with shovels. Its hair is coarse and blackish, but so sparse in one variety that the pink skin can be seen through it!

"This," my wife said after she had read through a dozen textbooks and reports in order to draw the illustration, "is something that is all right in a fantastic story. But it does not belong in a landscape."

That feeling was shared by as eminent a naturalist as Count Leclerc de Buffon, who just disbelieved the report delivered early in the eighteenth century by an explorer named Kolbe and declared it to be mythical. But it does exist: the exploring surgeon Pallas, who has been mentioned above, produced another description in 1766. And the later editions of Buffon's work quietly accepted *l'oryctérope*—skepticism is all right in its place, but there were too many people who had wrestled with aardvarks. This is to be taken literally, and it is quite dangerous, even though the aardvark does not bite and quietly subsists on termites which are lapped up with its eighteen-inch tongue. The traveler Fitzsimmons saw a native's leg broken with one blow of the fore-leg.

While usually escaping its hunters by digging, the aardvark can develop a considerable speed on the ground, if necessary. One older observer states that he saw one escape from a lion who gave up the

pursuit after a few leaps. Under such circumstances it is said to become bipedal for a short while and run on its hind legs only. It would be nice if somebody could take a film of such a performance; judging from the proportions of the body it does not sound at all unlikely. When walking slowly the aardvark sets its feet down in such a way that the spoor of the forefoot is overtrodden by the hindfoot. The result is a "synthetic" spoor which looks as if it had been caused by a gigantic lizard and which is a source of mystery and fright to many people who see it for the first time.[1]

Because of its powerful claws and almost incredible strength the aardvark does not have many enemies—not counting the natives—and among its enemies there is only one which is serious, the python, which can follow into the burrows and eat the young.

One should think that there should be a large amount of material about so strange an animal, but all important reports, omitting repetitions, could be printed on about fifteen book pages. (There is, however, a big and complete work on its anatomy.) And most of these reports concern the difficulties of catching one. Of the somewhat smaller and fairly naked Ethiopian variety (*Orycteropus aethiopicus*) it is known that the female gives birth to one young only at a time and that it is suckled for a long time. The larger and more hairy South African variety (*Orycteropus capensis*) presumably also has only one young at a time. The largest variety is Eriksson's aardvark (*O. eriksonii*) of the Mubangi, Wele, and Ituri regions of Central Africa, which was discovered as late as 1905. Its skin, which is the color of red clay, is very sparsely covered with hair and it has much smaller ears than the other two, especially than those of the Cape variety.

There are fossil aardvarken known, one from the Oligocene Period of France and another one from the Lower Pliocene of Samos, the latter (*O. gaudryi*) in quite complete skeletons. The trouble with the fossils is that they don't give us any pointers as to the ancestry of the living forms. They themselves are so definitely "aardvark" that, if found alive, they would be taken to be just one more species.

Not even the teeth are of any help, as teeth usually are when it comes

[1] Incidentally, this is the reason I have paid no attention to many stories of strange spoors in Chapter 8, "Rumors and Shadows."

to classification and to establishing relationships. "When unworn the teeth, which are of considerable size, have rounded summits. They are composed of a number of closely-packed denticles, which by mutual pressure assume a polygonal form, and are traversed by a series of radiating tubes; such a structure being unknown elsewhere in the whole mammalian class" (from Lydekker's *Library of Natural History*). It is hardly a help that we know fragmentary teeth from the Eocene of North America which resemble them in structure. Even the most modern book on extinct animals, *Vertebrate Paleontology* by Professor Alfred S. Romer of Harvard, has to dismiss the case with the remark, "It is possible that it is descended from early ungulates."

For some time zoologists were in hopes of at least establishing a relationship between the aardvark and another very old African mammal, the pangolin or scaly anteater. Laymen who see a pangolin in a museum are usually at a loss whether they should regard it as a pine cone from some especially gigantic tropical pine tree or as an exceptionally large lizard with unusually large scales.

Actually it is a mammal. There are seven representatives of that tight-knit little zoological family around, right now. Three of them live in Asia as their names (Indian, Chinese, and Malayan pangolin) indicate; the four others, called long-tailed pangolin, white-bellied pangolin, black-bellied pangolin, and giant pangolin, live in Africa south of the Sahara. All four varieties occur in the Ituri Forest, which seems to be as much of a "Lost World" as one can possibly expect. Of these four the long-tailed and the white-bellied pangolin prefer trees to the ground, the other two are burrowers. All live on termites and other insects. Some fossil remains (highly incomplete) have been found in the Miocene of Europe.

They are not related to the armadillos as was first assumed because of their scaly covering. They are not related to the giant anteater of South America with which they share some purely functional similarities. They are not related to the aardvark.

They are pangolins—direct offspring of very early placental stock which "fossilized" or "froze" so early in its evolution that it just remained what it was.

To the paleontologist all these survivors from the early age of mam-

mals form a fauna which he calls "Old Africa." Which is by no means the same as the African fauna so well known to the reader of books on Africa and to the visitor to the zoological garden. The animals he has in mind, the African fauna of today, is a fauna of late immigrants which arrived at a time when there was a more pronounced land connection between Eastern Europe (the Balkans of today), Asia Minor, and East Africa. The Europe of that time presented a curious mixture of African animals in American forests. The forests of Old Europe consisted of swamp cypresses and palmettos, palm trees, oak trees, and pine trees growing side by side. They sheltered quantities of giraffes, elephants of all descriptions, all kinds of zebralike horses, lions and other large cats, gnus and antelopes, and hordes of monkeys. The rhinoceros was present and hyenas abounded.

The Ice Age finished this paradise. It eradicated the tropical forests, which could not move south and continue to thrive in a European Georgia or Florida because the Alps were in the way. The fate of the animals was much the same; some adapted themselves, as is proved by the woolly mammoths, the woolly rhinoceroses, and others, but most of them simply died out. Only the Old European animals living south of the Alps, mainly in what is now Greece, did not have to adapt themselves: they could leave for the south. And it is for this reason that the African fauna of today looks so much like the fauna of Greece during the Pliocene sub-division of the Tertiary Period, just prior to the Ice Age.

Not very far from famed Marathon there is a small settlement known as Pikermi. In 1835 the British archeologist George Finlay went to Pikermi to look for promising sites for archeological excavation. He found none, but discovered a few fossil bones. When he showed them to an ornithologist named Lindermayer, that man of science became enthusiastic and persuaded Finlay to dig for more. Together the two men excavated a small collection of fossils which they took to Athens as a present for the local Natural History Society. At first no one much cared, but three years later a Bavarian soldier literally stumbled upon a deposit of fossil bones in the bed of a small river called Megalorhevna near by. The hollows of these bones were filled with glittering spar crystals, which the soldier believed to be diamonds. Thinking

himself rich, he returned to Munich and brought his find to Professor Andreas Wagner to get an evaluation. Wagner saw among the bones something that was then a great novelty, the jaw of a fossil monkey. He published a description of this surprising discovery of a fossil European monkey, and soon afterward intensive and prolonged scientific digging started along the river Megalorhevna.

The river, it was found, had once been much larger, and had dug a fairly deep canyon in the soft soil through which it flowed four million years ago. Large numbers of animals had fallen to death in that canyon, probably in flight from fires. Thus in one big sweep a significant period of the prehistoric animal life of southeastern Europe became known, and it proved so important that scientists began talking about the "Pikermi fauna." Present-day African fauna is to a large extent fauna of the Pikermi type, with additions and omissions, of course. A number of modern African animals did not exist in the Pliocene Pikermi landscape; and among the Pikermi fossils there are many types now extinct.

A typical example of extinct Pikermi fauna was *Helladotherium* ("the Hellas mammal"). It looked fairly much like a giraffe, but with shorter legs and a neck only slightly longer than a horse's. A relative of this animal, also fossil, was discovered later on Samos and was consequently named *Samotherium*. Both were regarded as completely extinct until shortly after the year 1900. Then the okapi was discovered in Africa. Paleontologists suddenly saw before their very eyes a living —or freshly killed—animal which was a close copy of their beloved Greek fossils. Small wonder that they began to talk enthusiastically of the "living *Helladotherium*." They could also have said—in fact they did—"living *Samotherium*," but neither term is quite correct. There are a number of small but distinct differences between *Helladotherium, Samotherium,* and the okapi. The best way to express the relationship is probably to say that the okapi stands midway between the two animals from Greece and the modern giraffe.

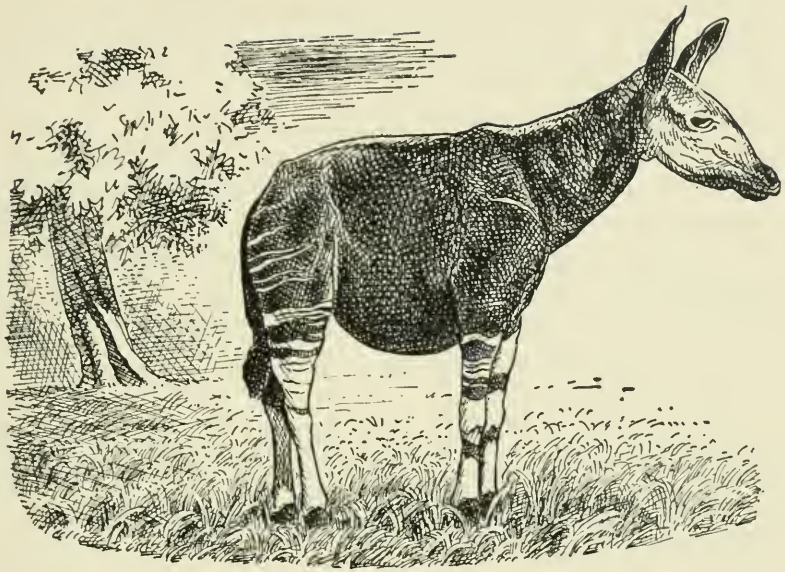
The okapi's first appearance in print dates back to about 1890, when Sir Henry Stanley's book *In Darkest Africa* appeared. Reporting on the language of the Wambutti, one of the pygmy tribes of the Congo region, Stanley remarked that a Wambutti he talked to knew a word

for "donkey." The word was *atti,* and Stanley's informant stated that the men of his tribe occasionally caught one in pits. Sir Harry Johnston, who is generally regarded as the "discoverer" of the okapi, wondered about this statement. He knew that zebras avoided dense forests. If the Wambutti had spoken the truth—and there was no reason why he should have lied—either there existed a variety of zebra which did not shun forests or there was another animal resembling a donkey in that territory. He decided to investigate at the earliest opportunity, which came in 1900.

In a letter dated "Fort Portal, Toru, Uganda, 21st August 1900," and addressed to the Zoological Society of London, he told how the discovery was made:

> When I entertained for months the Pygmy band which had been captured by a filibustering German (and the restoration of whom to their homes was one of my motives for going into the Congo Free State), I questioned them on the subject and they were very explicit; they told me that they called the animal *Okhapi.* They described it as being dun-colored or dark gray all over the upper parts of the body, with stripes on the belly and legs. As soon as I reached the Belgian post of Mbeni I began questioning my host, who at once acknowledged the existence of this animal and promised to send me where I could shoot one. . . . The Bambuba natives dwelling alongside the dwarfs called it *Okapi.* The Belgians state that the head is very long *"et très effilée."* One man said that the muzzle was particularly *effilé*—i.e., drawn out. At first they excited me by declaring that there was a skin lying about which I could have; eventually it was found that the skin had been cut up by their native soldiers to be made into waist-belts and bandoliers. Two of these fragments were found and given to me, and I shall send them home to you by first opportunity. Whatever the animal may be to which these pieces belong, it is not any one of the known Zebras or wild Asses; the pieces of skin unfortunately exhibit chiefly the stripes of the belly and legs. . . . We did not succeed in seeing a specimen of this animal in the Forest during our short stay, but one of the Congo Free State officials has promised to send me a complete skin and skull.

The two strips of okapi hide were exhibited at the December 1900 meeting of the Zoological Society and accepted as proof that an unknown variety of zebra actually did exist in the Congo forest. Tentatively (as denoted by the question mark) the animal was named



Okapi

(Drawing by Gustav Wolf)

Equus (?) johnstoni. In June 1901 a complete skin and two skulls arrived in London. That settled the question of what the new animal was, and Professor E. Ray Lankaster of the Natural History Department of the British Museum proposed the name of *Okapia johnstoni,* which is still in use.

Sir Harry Johnston himself pointed out that Stanley's mention of the *atti* was what had aroused his curiosity; and after talking personally to Stanley, Sir Harry even concluded that Stanley and his men had once caught sight of okapis west of the Semiliki River, years before he himself had seen the two strips of skin.

After okapi's true position among living animals had been established, and after several complete skins and skeletons had reached England and Belgium and had been mounted in large museums, the directors of zoological parks all over the world began to wonder whether the okapi might not be kept alive. True, it would be difficult to duplicate the conditions of its native forest, known among geog-

raphers and zoologists as the Rainy Forest, but other African animals had adapted themselves to a different climate and a new diet and had thrived on it.

Several expeditions were sent into the Belgian Congo, instructed, among other things, to keep an eye out for okapis. A German expedition under Adolf Friedrich, Duke of Mecklenburg, contented itself with shooting a few specimens for a museum group. But the American expedition under Herbert Lang was definitely on the lookout for live okapis for the Bronx Park Zoo. Lang, of course, made other collections for the American Museum of Natural History, ably assisted in this by young Dr. James P. Chapin, whom the natives referred to as "Mtoto na Langi" (Lang's son).

Lang soon found out why it had taken so long for the okapi to be discovered. In an article he wrote later for the *Bulletin* of the New York Zoological Society, he stated:

> The okapi, in true hermit fashion, had secured the only retreat that white man would respect, a country that he was forced to acknowledge as the most unhealthy in the world. It inhabits a narrow strip some seven hundred miles long and hardly one hundred and forty miles wide, about seven hundred miles from either coast. . . . Whoever penetrated here was, so to speak, "on the wing," and wings beat doubly fast across these inhospitable regions. The numerous sportsmen who had visited nearly all parts of Africa found no attraction in these forests. Indeed, the many pale, haggard faces that emerged from the western half of equatorial Africa were no incentive for pleasure-seeking people. The immensity of the wilderness is appalling; for over eighteen hundred miles without a break it stretches more than half way across the continent, from the coast of Guinea to the Ruwenzori. In spite of tropical luxuriance, it is one of the most dismal spots on the face of the globe, for the torrid sun burns above miles of leafy expanse, and the unflagging heat of about one hundred degrees day and night renders the moist atmosphere unbearable. Over the whole area storms of tropical violence thunder and rage almost daily. Here natives have become cannibals, and the graves of thousands of white men are merely a remembrance of where youthful energy and adventures came to a sudden end.

Lang's hope of being the first man to send a living okapi to the New World was thwarted by a number of unforeseen and un-

fortunate circumstances. The first okapi to be captured seems to have been a young animal that lived for a short time at a Belgian government post near the Ituri River. But it did not live long. The second was also a young one, captured in 1909 by Lang's men. To his pleasure he found it tame and friendly and eager for condensed milk. But there was only enough milk to last four days, and before a fresh supply could be brought to the outpost, the little okapi died.

A third young okapi was captured in 1915, when the Lang expedition had just returned to America. It was reared on a bottle at the mission station, where it remained until the war in Europe was over. By that time it was full grown and as tame as any tamed wild animal. It arrived in the Antwerp Zoo in August 1919, but lived only forty days after the voyage. Other okapis followed, all going to Antwerp in Belgium. In 1935, the King of the Belgians presented the Prince of Wales (now the Duke of Windsor) with an okapi. It was brought to the London Zoo, but lived there for only three months and a week. It died on November 4, 1935, the same day on which pygmy hunters frightened a female okapi away from her ten-day-old calf. The young animal was brought to the mission station at Buta, where the first Antwerp okapi had been reared. It did not die but grew into a remarkably beautiful specimen, which loves bananas, answers (or does not) to the name of "Congo," and now lives at the Bronx Park Zoo, where it arrived on August 18, 1937.

If the story of "Africa's unknown mammal," the okapi, sounds strange, the story of "Africa's unknown bird" is even more so. No one realized it then, but while Herbert Lang's expedition had been unsuccessful in obtaining a live okapi, it had acquired a substantial hint for the discovery of another living fossil, a discovery that was to be made many years later. Moreover, complete specimens of this animal were actually already in a museum, but they were not recognized. What was needed was, both figuratively and literally speaking, a new and correct label. The man who was finally to write it was "Lang's son," Dr. James P. Chapin—"Chapin of the Congo," as he is called behind the scenes in the American Museum of Natural History, or "Chapin of the Museum," as he is called elsewhere. The two, the man

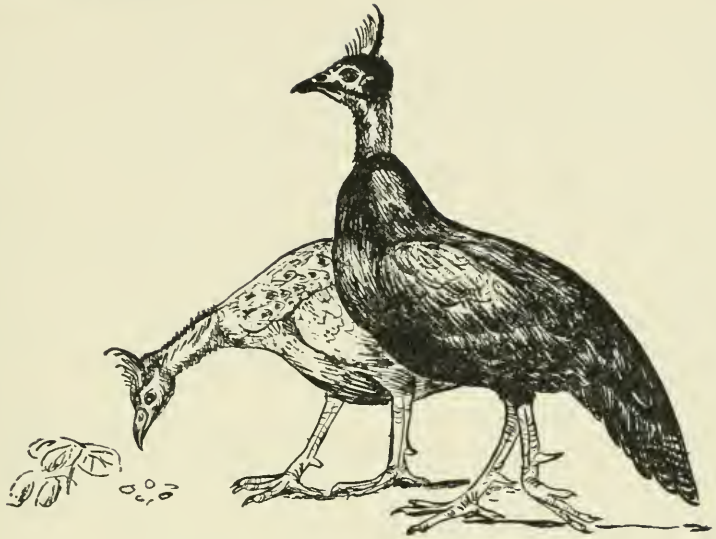
and the specimen, had only to come together, which finally happened after a series of odd coincidences. The specimen waiting to be "discovered" was a large bird—and the scenes of action were New York, Belgium, and the eastern part of the Rainy Forest between Stanleyville and Lake Edward.

During the first okapi expedition Chapin had often been annoyed with the natives because of their beastly habit of pulling the largest and most beautiful feathers from dead birds for use in their headdresses. On the other hand, the headdresses were collectors' items too, and a few of them were secured. When Dr. Chapin returned to America with his collection in 1915, he brought with him a small bundle of loose bird feathers to be classified at leisure at home. Classification in some cases proved difficult, but Chapin was able finally to place all of them except one large feather. This remaining nuisance might have belonged to a bird of the cuckoo family, but it was much too large. Its quill rather suggested a guinea fowl or some related bird, but its color pattern did not correspond to any known guinea fowl. For a short while Chapin thought of an undiscovered bird, but that idea seemed too preposterous. Finally he laid the feather aside.

In July 1936 Dr. Chapin left for Belgium. His destination was the Congo Museum in Tervueren near Brussels. His purpose was the study of the birds preserved there; the results of his study were to be published in the second volume of his great work on the birds of the Belgian Congo. After a friendly conference with Dr. Henri Schouteden, the director of the museum, Dr. Chapin began his work. While nosing about in a little-used corridor he saw two mounted birds on top of a cabinet. The birds looked like pheasants. As Dr. Chapin later wrote in an article in *Natural History Magazine:*

> Had I seen these specimens in any other museum, I might have paid little attention. But the Congo Museum contains practically no birds except those from Africa, and never had I seen any like these. They were somewhat larger than domestic fowls; one appeared blackish, the other more rufous. Yet the black-barred wing feathers of the rufous bird awoke a memory. We lifted them down, and found still attached to one of the stands an old cardboard label, reading *"Pavo cristatus, jeune, importé.*

Now the Latin word *pavo* means peacock, and *jeune* is French for



Congo peacock (*Afropavo congensis*)
(Drawing by Olga Ley)

young; but Chapin realized at once that the label was wrong. The birds were smaller than peacocks (probably the reason for the *jeune*), but the blackish specimen had large spurs which proved that it was full grown, or at least almost so. Then, of course, peacocks live in Asia, not in Africa. In fact neither peacocks nor true pheasants had ever been found in Africa. As Dr. Chapin expressed it:

> The pheasant family is well represented in Africa by quails, partridges, and francolins, but thus far nothing had ever been collected there that could truly be called a pheasant, with metallic luster on its plumage. The bird so often called "peacock" in West Africa, or *faisan bleu* in the Congo, is merely a giant member of the turaco family, related to the cuckoos.

Of course these two specimens might have come from Asia by some devious means. But they were also not known as Asiatic birds. Moreover, they showed feathers like the mysterious feather Dr. Chapin had picked up in Africa twenty-two years earlier!

The question of where the two museum specimens had been acquired could be answered at once by Dr. Schouteden. Before the First

World War the Kasai Company, a private concern, had had a trade monopoly in most of the Southern Congo Free State. It had accumulated a number of mounted birds, and in 1914 the whole company collection had been turned over to the Congo Museum. There were about sixty specimens in all, most of them well-known birds from Africa. Among them were a few domestic fowls and the two "peacocks" that were already labeled the way Dr. Chapin found them. Since this was not strictly an African collection, there was no definite proof that these two birds were either wild or African. They could be anything, and it was not impossible that they were hybrids of Asiatic peacocks and domesticated fowls. Still, there was that mysterious feather.

A very few days later Chapin had lunch with an old Congo acquaintance of his, one M. de Mathelin de Papigny, who had been an engineer in the Kilo gold mines in 1911. While eating, the engineer began to talk about food and told a story of a strange bird he had had for dinner in 1930 at his gold mine near Angumu, situated in dense forest almost under the Equator, not far west of Lake Edward. A native hunter had killed the bird, the first and only one the engineer had ever seen in twenty years of life in the Congo. He proceeded to describe the bird—and Chapin, I am sure, did not know just what it was he himself was eating at that moment.

For this was the bird that bore those mysterious feathers, the bird that had come to the Kasai Company as a "young peacock." There was hardly any doubt left: Africa's Congo forest harbored an unknown bird of the pheasant family. Its outstanding characteristic, which no other bird possessed, was a tuft of stiff white bristles on the crown of the male, just in front of the black crest.

A number of points had to be cleared up to establish the discovery. A feather from the wing of the female specimen was mailed to New York to be compared with the feather collected in 1913. It was found to be the same kind. Then a number of experts had to pass judgment on whether the specimens at the museum might be peacock hybrids. They all decided that they were not. The wing skeleton of the female was uncovered in search of a certain small bony protuberance which distinguishes the pheasants from the guinea fowls. It was there.

Then Dr. Chapin felt sure of his discovery. He named the bird *Afropavo congensis* ("African peacock from the Congo," or Congo peacock, as the name is usually translated). He embodied his findings in a report published in the November 1936 issue of the *Revue de Zoologie et de Botanique Africaines.* The article was reprinted in a magazine with wide circulation in the Congo and, abridged, in a Brussels newspaper.

Several persons wrote in saying that they had seen or shot such a bird. A police officer, M. R. Geldof, wrote that he had had his specimen mounted and given to his sister who lived in Eecloo in Belgium. The specimen was still there; it was a female. Dr. Chapin wanted to complete the story by collecting a few specimens in their natural habitat. But time seemed too short, until a chance meeting with Lincoln Ellsworth in London suggested flying.

After all kinds of preparations and after obtaining a two months' leave of absence from the Museum in New York, Dr. Chapin left Brussels by air on June 19, 1937. Meanwhile, several persons in the Belgian Congo had been instructed to hunt the Congo peacock, and even before Dr. Chapin left the Brussels airport, two specimens had been shot. When he arrived at the Stanleyville airport in the afternoon of June 23, reports of the shooting of six more were waiting for him. The birds were apparently not as rare as had been thought—although, of course, much rarer than other species—and the native hunters were well acquainted with the *itundu,* as the Bakumu call it, or the *ngowé,* as it is known among the Wabali. The latter name is an imitation of the bird's call.

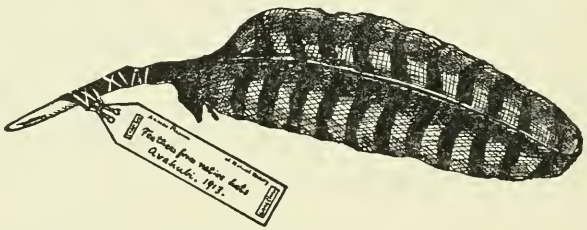
On July 16, 1937, Dr. Chapin saw his first living Congo peacock, a large male that took to the air with "a tremendous beating of wings." A native hunter named Anyasi, who accompanied Dr. Chapin, fired but missed. And while they were looking after the escaping bird, another one took off to the right of them. Two days later Anyasi shot a Congo peacock, the only one killed in Dr. Chapin's presence. Chapin, well satisfied with the results, left Africa from Port Bell, Uganda, on August 27, on an Empire flying boat, taking his specimens with him.

The scientific world was somewhat awed by all this. Africa, which had long lost the adjective "dark" and had come to be regarded as

completely explored and almost civilized—what with hydroelectric power plants, agricultural machinery, tourist hotels, bus routes, and airlines—suddenly turned out to be the home of a completely unknown bird—a bird that was noisy at night, that was by no means small, and that had been overlooked even though at least three specimens of it were preserved in Europe.

The passage in zoology books to the effect that "peacocks exist only in southeastern Asia" had to be deleted. There are also peacocks in Central Africa, and it is interesting to learn that the Asiatic peacock and *Afropavo* bear just about the same relationship to each other as the giraffe and the okapi. Giraffe and peacock are the more recent, the more spectacular, and the more specialized forms, while the okapi and the Congo peacock (both survivors from the past hiding in the same Rainy Forest) are the older and more primitive types.

And the Congo peacock brought everybody back to the old but open question which had begun with the okapi and been continued with Eriksson's aardvark and Meinertzhagen's black Forest Hog. The question: what else might there be in hiding in the Rainy Forest. . . .



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